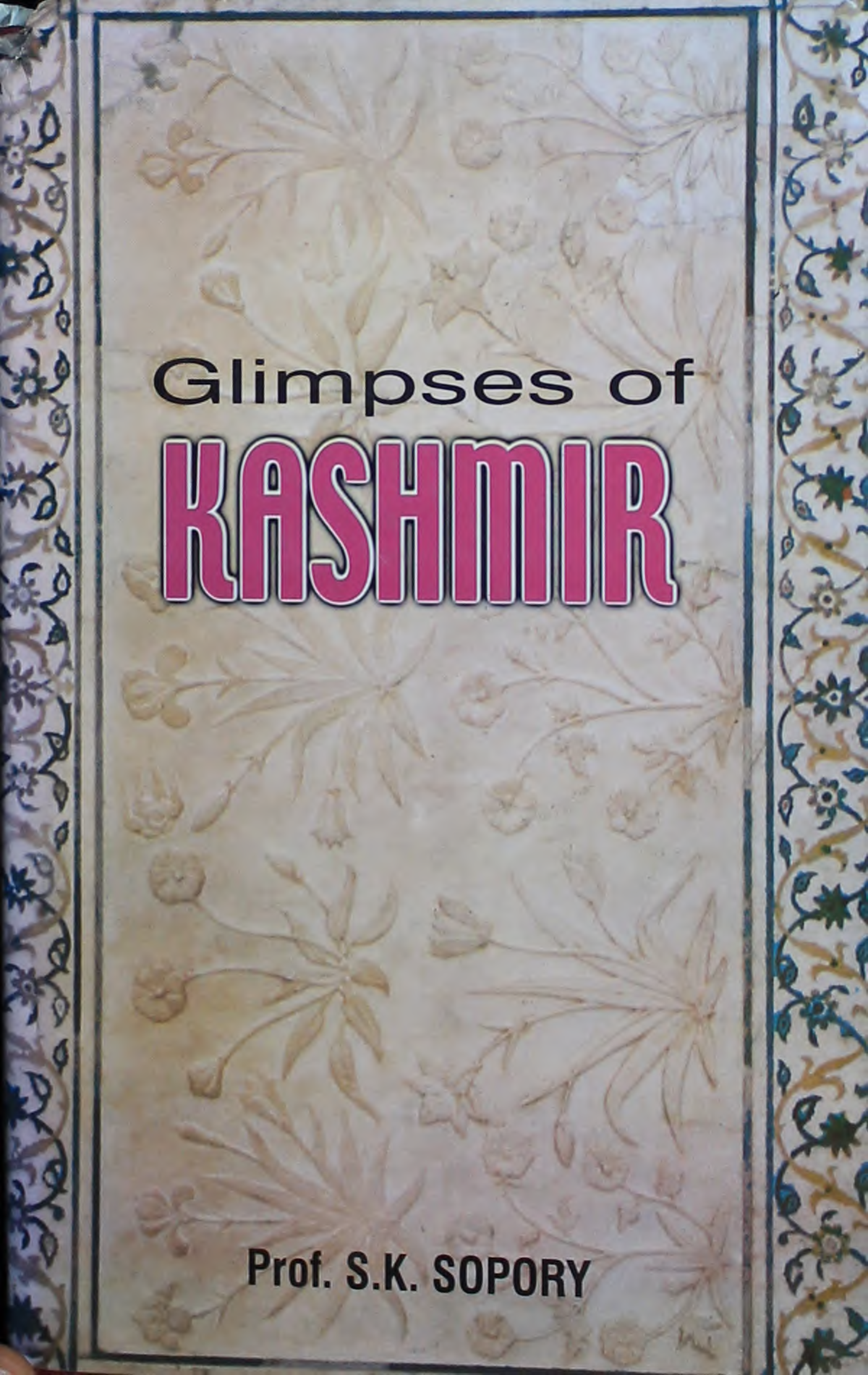

Glimpses of
KASHMIR

Prof. S.K. SOPORY

Present day science philosophy is moving towards a new synthesis of science and humanities, including the diverse cultural heritage of mankind. In fact it is a synthesis and unity of all knowledge which helps understand problems of our civilization. Leading scientists including Professor Iliya Prigogine in his book *Order Out of Chaos* and Stephen Hawking in his book *A Brief History of Time* have promoted a unity of all knowledge and harmony in society and with nature.

This book which is the proceedings of a national seminar makes an attempt for the synthesis of various scientific disciplines, as also a synthesis of science and culture and spiritual heritage of Kashmir. Leading Scientists, Scholars and Fellows of National Akademies took part in a seminar organized on 7th April 2002 by Kashmir Education, Cultural and Science Society in Pamposh Enclave, New Delhi, who provided major ideas and trends in research in various modern scientific disciplines as also the trends and focus of Kashmir's composite, cultural philosophy and spiritual heritage. This is heritage is represented for example by Kashmir Saivism, which along with Sufism, is known world over because of great scholars and seers of Kashmir's past like Lal Ded, Nund Rishi and Abhinav Gupta being associated with it. Professor M.G.K. Menon the distinguished scientist of India delivered the inaugural address. He said there is harmony between science philosophy and Kashmiri philosophical and cultural heritage. This book should be of interest to scientists and public at large as it makes an attempt to provide a synthesis of modern science and spiritual and cultural ideas of Kashmir.

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GLIMPSES OF KASHMIR

Science and Kashmiri Heritage

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Editor
Dr. S. K. Sopory

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PREFACE

A national seminar was held on April 2002 in New Delhi by Kashmir Education Culture and Science Society (KECSS) on the subject of "Science and Synthesis and Kashmiri Heritage" the participants included leading scholars in science and scientific research, some of them being fellows of the National Academics of Sciences in India with global reflections. Besides, there were scholars from lumanie, who presented their views on the philosophical aspects of Kashmiri heritage. Thus we had an occasion when knowledge from various disciplinary of science and humanities could be seen on one platform and in one perspective for human enlightenment.

It may be recalled that KECSS is making efforts to establish a national center for Kashmir studies with a view to provide information of knowledge from past history with modern scientific research. The seminar was one among several others that KECSS has held in recent years to revive the ancient learning from Kashmir. Kashmir has been, a seat of outstanding knowledge and ideas including the philosophy of shaivism and contributions made by scholars like Abhinav Gupta that many scholars in the west today feel holds great promise for the unity and progress of mankind.

This book should be of much academic and intellectual interest worldwide. The president of KECSS Mr. K. Kaw and his colleagues including Prof. B. B. Dhar and S. Bhatt, have provided ample support to make this seminar a success. Mr. J. L. Bhatt the General Secretary KECSS and other executive committee including Dr. Vinod Kaul the Treasurer members provided excellent arrangement for the seminar. We are thankful to all. The publication of proceedings have been delayed due to unavoidable circumstances. We regret this delay.

1.8.2003

Prof. Sudhir Sopory
Convenor of Seminar and
Editor of Proceedings

INAUGURAL SESSION

WELCOME ADDRESS

by Mr. M. K. Kaw
President KECSS

Today is an important day for us. For a long time, we have been debating within the KECSS as to what our society can do in the field of science. I am grateful to Prof. Saligram Bhat and Prof. Sudhir Soporay for conceiving the idea of a Seminar on Science and Synthesis. We hope to encourage the study of science within the Kashmiri community by honouring our prominent scientists. In order to keep the choice of the scientists above controversy, we decided to honour all those Kashmiris who have been elected as Fellows of our various Science Academies. Their telling us what they have been doing and the latest developments in their branch of specialisation would also benefit us. In our session on synthesis, we are trying to bridge the gulf between science and spirituality.

I am glad that a world-renowned scientist like Prof. M.G.K. Menon has agreed to preside over the inaugural session and found time, among his multifarious engagements, for a small organization like ours. He is an old friend and I welcome him to the Seminar.

I also welcome today's guests—scientists who will be honoured by us and scientists who have honoured us by their presence. I welcome our KECSS members and other guests specially invited to today's seminar.

KECSS has started a number of activities. A time has probably come when we should think of institutionalizing the organization. There are two ideas for your consideration. One is the creation of a permanent Centre for Kashmir Studies, which will be the research wing of the organization. The other is the setting up of International Consultative Council with about 100 members from all over the world. We have our own website now which can be accessed at kecss.net.in. We have already started a Quarterly Research Newsletter and decided to bring out an annual Journal of Kashmir Studies. Thus it should be possible to meet the aspirations of all members of the Kashmiri Diasporas spread all over the globe, in a meaningful way, without incurring too much expense.

Friends, I welcome you again to this Seminar.

ABOUT THE SEMINAR

By Prof. S. Bhatt

Esteemed by Mr. M. K. Kaul, President of KECSS, Prof. M. K. K. Menon, our distinguished speaker for this seminar, honorable fellows of Science Academics, ladies and gentelmen. I have pleasure to say a few word about this seminar organized by KECSS. Firstly, we have assembled today to honors the fellows of science academies who have done India proud and this institution proud, by their contributions to Science. In the temple of science, as Einstein said, these fellows worship science and scientific research not for any business interest, but for their devotion to science. So we are looking forward to their brief presentations today relating to their works on science. Secondly in regard to the title of seminar "Science and Synthesis" an attempt is being made to combine knowledge of science and humanities in one perspective. Thus we have seminar papers on science policy, environment management, excellence in medicine, Kashmir Shaivism, a philosophy known would ever, Kashmir heritage, archaeology, science and spiritualism etc. The synthesis of knowledge aimed in this seminar provides us an intellectual opportunity to study the global environment movement and its leading scientific principles such as conservation, harmony with nature, unity in diversity of global life and harmony among different sections mentioned which seeks like Lal Ded, Nund Rishi. Abhinav Gupta promoted for world society. We now look forward to the address of Prof. M. G. K. Menon who has been very kind to find time to address this historic seminar. We are thankful to Prof. Sudhir Soporay, himself a fellow of National Academies, who holds Bhatnagar award in science, for communicating with other fellows and helping organized this seminar.

INAUGURAL ADDRESS

By Prof. M. G. K. Menon

Mr. N. K. Kaul, fellows of academies distinguished members of audiences ladies and gentlemen I am pleased to be have today to talk about science and synthesis. I wish to refer to the loss of three eminent Kashmiris recently who were also known in service at the national level. These included Dr. M. L. Dhar, Dr. C. K. Bhat and Mr. R. N. Kaws.

There is the fundamental unity in everything living and non-living parts of nature are interdependent. Unity in diversity is the order of nature. India's philosophy has to offer much to the world. Its major emphasis in unity in diversity. We have enormous cultural diversity. Yet, diversity should not divide humanity. We have seen the tragedy in Kashmir and Gujarat in recent times where diversity has been used to divide people and mankind. Vedanta provides an integrated view of universe. I have visited Kashmir many times in the past and used to find harmony and peaceful embroilments. The philosophy of shaivism, sufism provided tranquility among people.

Science has helped in globalisation of knowledge and comforts for mankind. Computers have given a new universal language and brought the world together. Modern science has synthesized knowledge of physics, biology etc.

Science motivates for new research. It provides a scientific temper as Pt. Jawahar Lal Nehru said and leads to a rational view of life. Once again, science is based on the creative enterprise of humanity's high diversity with the basic principles for unification. History and cultural diversity support the scientific view of life.

I am sure this seminar on science will keep synthesize knowledge in order to meet challenges of our civilisation. It will provide harmonius outlook between people and of man with nature. It will help to promote scientific temper and a creative life for the country.

Thank you all.

VOTE OF THANKS

Prof. Sudhir Sopory

This is the first seminar on Science being held by KECSS and we were very happy that no other person than Prof. M.G.K. Menon consented to inaugurate it. We are grateful to you for accepting our invitation. This seminar provides, being the first does not revolve around a specific theme; this was organized more from the point of view of getting to know each other work and also an opportunity for scientists to meet their counterparts in the field of social sciences, international relations, religion and philosophy. The idea to hold this meeting was initiated by Prof. Bhatt and Shri Kaw Sahiab and approved by the EC. Their consistent support to me to organize this meeting has been coming all through and I am thankful to all the EC members especially to the secretary, Dr. B.B. Dhar and the treasurer. And finally thanks to the fellows of the academies for having accepted to come here, some of them coming from outside are travelling on their own. We hope our deliberations will help us chart out a role for KECSS to contribute to the development of science in this country in particular and society in general.

CONTENTS

Preface .... *v*
Inaugural Session .... *vii*
About the Seminar .... *ix*
Inaugural Address .... *xi*
Vote of Thanks .... *xiii*

Part I : Contribution of Kashmiri Scientists

1. Animal Production, Biotechnology and Poverty Alleviation . 1
2. An Overview of Numerical Methods for Boundary Value Problems - Author's Contributions 7
3. Biopesticides: Ecofriendly Concept of Pest Management 17
4. Plant Behaviour and Adaptation 27
5. Dr. M. J. Zarabi 31
6. Prof. D.P. Zutshi 37
7. Science Policy in India 43
8. Abstract of Address to the Indian Science Congress - 1986 51
9. Pharmacy as a Career 55
10. Evolution of Medical Practice in Kashmir and Role of Kashmiri Medical Scholars 61
11. Developments in Science of Archaeology in Kashmir 75
12. Body's fight against cancer 85
13. Science and Spirituality 89

Part II : Science, Spirituality and Kashmir Shaivism

14. Science and Kasmir Shaivism 97
15. Reflections on Science and Shaivism 107
16. Science and Kashmiri Heritage 113
17. Science and Kashmir Shaivism 119
18. Reflections of a Physical Scientist 129

Index 141

PART - I

CONTRIBUTION OF KASHMIRI SCIENTISTS

CHAPTER-1

ANIMAL PRODUCTION, BIOTECHNOLOGY AND POVERTY ALLEVIATION

Prof. (Dr.) P.N. Bhat

Chairman, World Buffalo Trust, NOIDA

INTRODUCTION OF AUTHOR

Dr. P.N. Bhat was born in village Nunar, Ganderbal, Kashmir in October 1937. His initial schooling was done at Government Middle School, Nunar, Citi Public School, Chattabal, National High School, Karanagar and Sri Pratap College, Srinagar. He was selected for a loan scholarship to undergo a Bachelor's Degree (BVSc and AH) at Mathura Veterinary College at Mathura. He finished with distinction in Animal Genetics with a Silver Medal in 1959. On the basis of an All India Competition, he was selected for undergoing a Master's Degree in Animal Genetics at Indian Veterinary Research Institute on a Government of India Fellowship. While doing his Master's Degree, he was selected for a U.S. Atomic Energy Fellowship to study population genetics at Purdue and Columbia. On his return he joined Punjab Agricultural University at Hissar and moved to Jabalpur to establish a new department of Animal Genetics and Breeding. In 1970, he joined ICAR as Project Coordinator, All India Coordinated Project on Animal Breeding to establish coordinated projects in Cattle, Sheep, Goats and Pigs. He was selected to establish the Central Goat Research Institute in

1982 and subsequently moved to IVRI as Director and Vice-Chancellor where he served two terms. Moving to Delhi as Deputy Director General (Animal Sciences) in 1992. He took over as Additional Secretary and Animal Husbandry Commissioner to Government of India in December 1992. Dr. Bhat has received several recognitions globally particularly for his work in Middle East and South East Asia besides in his own country. He is a member of several Science Academies and recipient of several prestigious awards including P. Bhattacharya Memorial Award of National Academy of Agricultural Sciences (NAAS). He has recently finished the Working Group Report on Animal Husbandry and Dairying for the Xth Plan of Government of India. He is currently International President of Asian-Australasian Association of Animal Production Societies (AAAP) and is organizing Xth International Congress of the same during September 2002.

Seventy percent India's rural population has no access or little access to land. Sixtyseven percent of these own livestock. Most poor belong to this category and many poorest of the poor are essentially belong to this sector. While in Europe, America and other developed countries, the richest of the rich are those who own livestock farming enterprises. This contradiction and its resolution in its holistic manner has been a major area of concern with which I have dealt over the past four decades.

One of the major and obvious concerns has been the genetic improvement in levels of productivity in Indian livestock species in the context of the environment and ecologies where they live and produce in. If you look at the genetics of sixties, it was obvious that using the straight forward methods of selection, and breeding systems using culling levels, traditional change in genetic gains (Δg) would need a period of 120 years to move 600 litres of milk production of an Indian cow to a production level of 1,200 litres per year which even by the standards of sixties was financially unviable, could not sustain the production system nor would add to farmers income. It was therefore realized that at least a production level of 2,500 litres/year would be a viable option. Hence, the genetic technology was to focus on a system, which would zero in on this level of production.

Basic model based on the then theory of inbreeding was developed which involved the concept that if two lines one superior in production was continuously crossed to another relatively inferior breed, in about 12 to 15 generations, one would get a pure bred of the superior line/breed. This was essentially based on the maize model and in general was acceptable in the plant breeding sciences where enough experimental evidence had been obtained to establish this genetic dogma. Various modifications of this concept in terms of recurrent and reciprocal selection involving a number of lines of plants/poultry had been used in fifties to experiment with commercial production of poultry with some success.

We were fortunate to have available to us the data on dairy cattle in the Military Dairy Farms in somewhat organized design in which Sahiwal Cows were continuously crossed to Friesian Bulls to produce what the Generals called Indian Friesians. On return from USA, I was asked to develop a design for a major enterprise involving genetic improvement of livestock using this basic model. A detailed analysis was conducted between 1970 to 1975 on the data obtained in the Military Dairy Farms and similar other experiments conducted in the states including the experiment on sheep conducted by Dr. Koul from 1937 onwards to develop Kashmir Merino. One surprising feature in all these data was that the improvement obtained in the first generation of breeding was the maximum level of productivity regardless of the number of generation of crosses used in upgrading. Most of my predecessors had explained this away by assuming that the genotype by environment interaction (geo-climate) was responsible for this phenomenon. We examined several sets of data from Soviet Union, Jamaica, Australia and United States and we found that this was a problem, which needed to be looked at from basic theoretical consideration of genetic variation in its entirety including G x E interaction. Starting with Fishers' concept and utilizing Mather's basic work on inbreeding and hybridization. We ran a computer simulation study starting with a completely homozygous line for one gene and went on adding in each round one additional gene till we developed a model where milk production was supposed to be resulting from 4 major genes and a plethora of minor genes in crossbreeding programme. We came up with the results that the maximum yield in milk production could be obtained only in the first generation. Being primarily the first hybrid and in subsequent process of crossing there was segregation of genes and the entire population so generated could vary from zero spectrum of a normal distribution to almost 100% on the other side. In order to verify this conclusively one would need to generate about 40,000 genotypes to get to the fact. By 1978, we postulated conclusively that when two segregating populations, one superior and another inferior in productivity are continuously crossed. The maximum genetic improvement is obtained in the first generation only. It is not possible to develop a pure bred by continuous crossbreeding in one direction. This was published in 1978 in theoretical and applied genetics.

This basic dogma was tested along with other theoretical concepts of GxE interaction hybridization and additives genetic variance in four crossbreeding experiments on cattle, sheep, goats and poultry. Thus All India Coordinated Projects for improvement of livestock were born and by 1980 this basic concept was conclusively proved. Consequently, the breeding strategies for genetic improvement were revised and today, we have 16 million crossbred cattle moving into the national milk herd every year and our milk production of 84 million tones has become sustainable phenomena.

It was however realized from a review of several programmes, directed at overall improvement in livestock using technologies of health, production and Technology assessment that while traditional genetic technologies might be all right for farm level situation. These technologies could not be implemented in the Indian villages where production is generated. Therefore, alternative technologies need to be developed. Consequently, we developed the use of embryo transfer as an adjunct to our bull production programmes. A major project on embryo transfer technology was initiated in 1985 in a mission mode route at a cost of Rs.35 crores. This technology has since been refined and now it has been realized that an alternative to traditional genetic improvement could be obtained through direct animal cloning of livestock species. It is unfortunate that we have not been able to capitalize on this technology for a number of reasons. But if India has to alleviate poverty of poorest of the poor then apart from availability of micro-credit and institutional support, market access, it is necessary that he have access to technology which is to be underwritten by service providers. This is the basic theme of my report on Animal Husbandry and Dairying for the Xth Plan to the Planning Commission.

CHAPTER 2

AN OVERVIEW OF NUMERICAL METHODS FOR BOUNDARY VALUE PROBLEMS - AUTHOR'S CONTRIBUTIONS

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To be presented at the Seminar on Science and Synthesis held on April 7, 2002 organised by KECCS, New Delhi.

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PROFESSOR: *I.I.T.Kanpur, since March 1991.*

Introduction

The development of efficient numerical methods for solving boundary value problems in differential equations (both ordinary and partial) has been of fundamental importance because of their frequent occurrence in several areas of Sciences and Engineering.

The author in his last two and a half decades of research has been engaged in the development and analysis of new methodologies/algorithms for solving a wide range of boundary value problems in ordinary and partial differential equations. It is very difficult and rather impossible to describe even rudimentary details of our entire piece of work in such a short lecture, and only a brief summary without technical details is presented here below in chronological order starting with mid seventies :

Elliptic and Parabolic Boundary Value Problems

Boundary value problems for non-linear partial differential equations occur very frequently in the mathematical modelling of physical problems arising in Bio-medical Engineering, Numerical Weather Forecasting, Optimal Control Theory, Radiative Transfer, Reactor Kinetics of the moving material and many other areas of Physics, Engineering and Biology. In several situations one is confronted with the formidable task of obtaining solutions of these problems in realistic domains, which may not necessarily be regular.

Since closed form solutions for these problems are not possible, except for certain linear problems, a resort to numerical methods for obtaining the solution is inevitable. We have attempted to devise and develop numerical methods based upon the notions of Invariant Imbedding, Dynamic Programming and Quasilinearization for solving some non-linear elliptic and parabolic boundary value problems over regular and irregular regions. Stability analysis of the proposed methods, wherever necessary, has been presented and several test examples including Minimal Surface Equation and Burger's Equation have been solved to illustrate the theory. The details of these works can be found in serial no. 1-4,6 of my list of publication appended at the end of this paper.

Basically there have been two ways to solve the discretized elliptic boundary value problems, namely the direct and indirect (iterative) methods to solve the resulting algebraic systems. Mid Seventies and later was an era of direct methods and these were popularly known as Fast Elliptic Solvers. As a sequel, we developed a new and efficient direct method, namely the Symmetric Marching Technique, for solving the discretized Poisson equation with Dirichlet and mixed boundary conditions on rectangular regions. This was combined with a mesh refinement technique to compute Solution on finer grids efficiently. The method then was extended to tackle nonseparable elliptic equations and more general elliptic equations with mixed partial derivatives. The adaptability of symmetric marching technique to elliptic problems over irregular regions was demonstrated by presenting two approaches - one of which was found to be closely connected to the discrete Green's function. The proposed method was extended to solve nonlinear elliptic boundary value problems as well. Details of this research can be found in serial no. 8-13,17 of my publication list.

Singular Boundary Value Problems

Another area we have worked on is singular boundary value problems in ordinary differential equations, which although mathematically well conditioned, and yet are difficult to solve with analytical procedures. These problems arise in several areas of Science and Engineering and some of the notable problems are: heat conduction through a solid with heat generation, the equilibrium of isothermal gas spheres; the formulation of heat and mass transfer within porous catalyst particle; the famous Thomas-Fermi model in atomic physics; the Ginzburg-Landau Equations; the elastic stability of thin shallow spherical shells subject to uniform pressure; the Von-Karman Swirling flows; a combined forced and free convection flow over a horizontal plate, an eigenvalue problem for the Schrodinger equation; Falker-Skan equation in boundary layer theory. Unsteady flow of power-law fluids, Flow through porous medium and several others.

We have developed new and efficient numerical methods based on shifted Chebyshev polynomial, Continuous invariant and imbedding and variable step size initial value techniques to solve singular boundary value problems with a regular singularity. Wherever, it has been found to be difficult to remove the singularity using series expansions, a new method based on modified fourth order finite difference method and cubic spline method have been derived to solve linear and nonlinear singular boundary value problems over both finite and infinite intervals. The methods have been analyzed for stability, wherever necessary. The details of this work can be found in serial no. 15-16,19-20,25 of the list of publications.

Singular Perturbation Problems

Singular perturbation now is a maturing mathematical subject with a fairly long history and a strong promise for continued important applications throughout science and engineering. A singular perturbation problem is well defined as one in which no single asymptotic expansion is uniformly valid throughout the interval as the perturbation parameter $\varepsilon \to 0$. The singular perturbation problems find place in many areas of engineering and applied mathematics, for instance: fluid mechanics, fluid dynamics, quantum mechanics, plasticity, chemical reactor theory and many other areas of fluid motion. A few notable examples are boundary layer and WKB problems, the modelling of steady and unsteady viscous flow problems with large Reynolds number, convective heat transport problems with large Peclet number etc. We have been engaged in developing numerical methods for solving singular perturbation problems for more than fifteen years and have devised a variety of means to tackle these complex and challenging problems. The methods so devised are mostly non-asymptotic and include numerical integration in conjunction with discrete invariant imbedding, the method of inner boundary condition, boundary layer technique, terminal boundary value techniques, and an initial value technique. The complete details of these methods are given in papers at serial no. 24, 29-33, 36-41 of the list of publications.

The methods based on cubic spline and variable mesh cubic spline have been developed for solving linear and nonlinear singularly perturbed initial value and boundary value problems. These can be found in serial no. 52-58 of the list of publications.

In the theory of elliptic boundary value problems, the phenomenon called "fundamental solution" plays an important role. Fundamental solution and Green's function are very closely related and, in fact, they are almost one and the same. The difference between the two is that Green's function is associated with a boundary value problem (i.e. with the differential operator and the boundary conditions), whereas fundamental solution is associated with only the differential operator. Once the Green's function is constructed, the solution is readily represented in terms of the integral of the Green's function and other data of the problem. We know that the method of boundary integral equations is the starting point of today's Boundary Element Method. Here, too, once the fundamental solution is introduced in place of the weighting function, we get a readymade representation of solution in terms of the boundary integrals. To that extent, the fundamental solution is very vital in the boundary element method.

We have provided a simple and effective numerical method for singularly perturbed elliptic boundary value problems using the boundary element method. This involved the construction of fundamental solution in a very special way so as the boundary element method suits to singular perturbation problems. Helmholtz equation involving a large parameter is solved by first representing the fundamental solution in terms of Hankel function, which, in turn, is expressed in terms of an asymptotic expansion. This forms the base for the boundary element method and the problem is efficiently solved. The bounds for the error due to numerical integration involved in the method are derived and shown to tend to zero as the parameter $l \to \infty$. This ideas has been extended to a rather more general linear singularly perturbed boundary value problems of elliptic type in two dimensions. The dual reciprocity method is presented to construct and evaluate the fundamental solution in an algorithmic way. An iterative technique for non-linear singularly perturbed elliptic boundary value problems is presented and the method is applied to a physical model in the Semi-Conductor Physics, which happens to fall under the category of the singular perturbation problems. All this can be found in serial no. 69-71,73 of the list of publications.

The theory of singular perturbations is not a settled direction in mathematics and the path of the development is a dramatic one. In the intensive development of science and technology, many practical problems, such as the mathematical boundary layer theory or approximation of solutions of various problems described by differential equations involving large or small parameters, become more complex. In some problems the perturbations are operative over a very narrow region across which the dependent variable undergoes very rapid change. These narrow regions frequently adjoin the boundaries of the domain of interest. Consequently, they are usually referred to as boundary layers in fluid mechanics, edge layers in solid mechanics, skin layers in electrical applications, shock layers in fluid and solid mechanics, transition'points in quantum mechanics and Stokes lines and surfaces in mathematics. Numerical analysis and asymptotic analysis are two principal approaches for solving these singular perturbation problems. However, the asymptotic analysis for differential operators has a developed theory mainly for the case of regular perturbations. Consequently, there has been a continued effort by researchers to find simple and satisfactory numerical methods to solve such problems. In this direction, we have developed numerical methods based on spline in tension, spline in compression, variable mesh cubic spline, exponentially fitted spline for solving linear and nonlinear singular perturbation problems, turning point problems having boundary layers and the turning point problems having interior layers. The methods so developed have been analysed for convergence. The details can be found in papers at serial no. 76-90 of the list of publications.

Singularly Perturbed Systems

It has been, by and large, a fancy of mathematician to invent and do such mathematics which has no obvious applications.

However, most of mathematics that we do today have its origin in real life problems, or say, applications. Singular perturbation came into existence, not by fancy, but by necessity, and thus it belongs to the latter category. We have already mentioned earlier the occurrence of this in several applied areas. There is one more noteworthy application area of singular perturbation: optimal control theory. Compared to numerical treatment for handling systems of singularly perturbed two point boundary value systems, much has been done by the asymptotics. Amongst the problem classes, much attention has been paid to linear homogeneous systems because of their occurrence in a wide range of applications. For example, in optimal control theory, when a scalar (quadratic) cost is optimized subject to the states modelled by ordinary differential equations containing a small parameter ε $(0 < \varepsilon << 1)$ which typically represents small mass, inductance, capacitance etc. It happens that the resulting differential system to be solved becomes singularly perturbed. An engineer or an applied mathematician needs efficient techniques which can routinely be applied to obtain accurate solutions. In response to this need, we have presented simple but efficient techniques based on decoupling transformation and Euler's forward and backward difference schemes to solve singularly perturbed boundary value systems. Some more novel techniques, namely, the boundary value technique and the cutting point technique have been proposed, which exploit the boundary layer thickness. Nonlinear problems are solved via a modification of Newton's iteration, and the methods developed are applied to some optimal control problems, both linear and nonlinear. The details of this research can be found in papers at serial no. 42-51 of the list of publications.

Parallel Solvers for Linear Systems

The introduction of parallel computers about twenty five years ago provided an opportunity and prompted a need to develop parallel algorithms. Today, parallel computing has emerged as a subject of enormous interest. Numerical Linear Algebra is an indispensable tool in scientific and engineering research. Numerical linear algebra algorithms form the most widely used computational tools in science and engineering.

The problem of solving linear systems $Ax = b$ is central to the field of matrix computations. We have shown that the nonsingularity of the tridiagonal system is not a sufficient condition for the existence of the new quadrant interlocking factorization and prove its existence in the important cases which occur frequently in scientific computations, that is, when the coefficient matrix A is (i) diagonally dominant in addition to the nonsingularity and (ii) symmetric positive definite.

We also have developed parallel elimination method for general linear systems that is suitable for S.I.M.D. parallel computers. Existence and uniqueness of the resulting factorization is proved. Parallel algorithm for bounded linear system is introduced and analysed. Some application areas too have been considered. The details are in papers at serial no. 59-60 75 of the list of publications.

Parallel Algorithm for Singular Perturbation Problems

Parallelism is fairly common in every day life. We all tend to think intuitively that two skilled people working concurrently can finish a job in half the amount required by one person. It is natural for people to think of applying the idea of parallelism to every field in science and engineering. Parallel computer consists of several processing units (or processors) that can operate separately. A problem to be solved is thus broken into a number of subproblems, each of which is solved on one of the processors. The net effect of this parallel processing is usually a substantial reduction in solution time. The rapid progress in parallel computation has increased the interest and the efforts towards parallel algorithms for various problems. Several parallel algorithms have been developed and analysed for solving singular perturbation problems both in ordinary and partial differential equations. These algorithms include: Parallel Discrete Invariant imbedding algorithms, Parallel WDZ algorithm, Parallel Alternating Group Explicit algorithm, Parallel Modified Alternating Group Explicit algorithm. The details can be found in papers at serial no. 61-68,74 of the list of publications.

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CHAPTER 3

BIOPESTICIDES: ECOFRIENDLY CONCEPT OF PEST MANAGEMENT

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Biopesticides include in a broader sense, pesticides of biological origin. Thus the encouragement of natural enemies (parasitoids, predators, microbes, etc.) and the use of transgenic crop varieties, pheromones, growth regulators and plant-derived materials in pest management constitute the biopesticide umbrella. Biopesticides have been gaining increased attention and interest among those concerned with developing environmentally friendly, safe and Integrated Crop Management (ICM)-compatible approaches and tactics for pest management (Copping and Menn, 2000). At present, biopesticides are conventionally applied and successfully utilized in speciality and niche agricultural and horticultural situations. The world biopesticide market, excluding genetically modified crops, is claimed to be around US $ 350 million, representing little more than 1 per cent of the total world pesticide market (Menn and Hall, 1999). This low level of acceptance of biopesticides is the result of several factors, often including inconsistent field results, usually a limited shelf life, improper formulations, economic constraints and a very limited range of target pests. However, on the other hand the significant advantages of biopesticides are their safety to non-target organisms and mammalian systems, their environmental fit and a bit relaxed registration policy in recent years. A recent survey on the European market alone for biopesticides predicts biopesticide sales to reach US $ 167 million by year 2004 (Neale, 2000). The growth rate of biopesticides over the next 10 years has been forecast at 10-14 per cent per annum, in contrast to 2 per cent for chemical pesticides (Menn, 1996). Currently, there are reports on more than 170 active ingredients in over 500 biocontrol products (Copping, 1998). Approximately 45 biopesticide products were registered by the US-EPA by 1995 and it was estimated that this number will approach 100 by the end of the year 2000 (Copping and Menn, 2000). In addition to well known botanicals that make use of the diversity found in nature itself, micro-organisms and their derived products, animal derived products, nematodes, protozoa, predators and parasitoids, which constitute the aura of biopesticides, transgenic crops have also been brought under the umbrella of biopesticides. The global area of genetically improved crops is likely to reach 125 million acres according to an independent survey by the International Service for the Acquisition of Agri-biotech Applications and represents a 30-fold increase in last 6 years. Overall scenario indicates that there are challenges and constraints faced today though umpteen studies in terms of emerging trends of biopesticides in pest management have been documented. Various issues of microbial biopesticides, botanical biopesticides, biotechnological approaches in plant protection, disease management strategy, eritomopathogenic nematodes, mycopesticides as a component of integrated pest management, protozoans in insect control, etc. have also been dealt with comprehensively (Koul and Dhaliwal, 2001, 2002). It, however, seems that there is a need of cohesive approach if biopesticdes have to be successful vis-a-vis the conventional pesticides.

ANTIGONADAL CONCEPT

My contribution to biopesticide research, particularly the role of phytochemicals in pest management, dates back to middle of 1970s which was a step to achieve the method and non-toxic plant based material to sterlize various insect pests. Substantial success was achieved with two plants *Aristolochia bracteata* and *Acorus calamus*. The active compounds aristolochic acid-I and β-asarone were the active ingredients isolated from these plants, respectively. The significant achievement through this study was that the mechanism of action of these plant prodcuts was quite different from the male sterile technique prevelant globally at that time. One of the interesting findings in these studies was the induction of sterility in both sexes in insects. The eggs of normal females when inseminated with the sperms from treated males failed to hatch because sperms were unable to undergo typical morphological differnetiation in the female tract. Similarly, in case of females the treatment induced ovarian dysfunction, reduced follicular growth and failed to ovipoist normal eggs. It was established that the compounds severely depressed the development of gonads. The neurosecretory cells (NSC) scored by biochemical procedures, and various hormonal studies revealed totally a different mechanism of action and was established as a new antigonadal mechanism of inducing sterility among insect that could afford new and safe appraoch towards insect control (Saxena *et* al., 1977). It was in subsequent studies that essential oil from the Indian sweetflag, *Acorus calamus* L. was found to be not only a sterilant but an effective insecticidal, ovicidal, antifeedant and growth inhibitory plant product in which the activity was due to active principles, α and β-asarones. These phytochemicals are biologically active against coleopteran, heteropteran, dipteran, hymenopteran and lepidopteran insects.

A detailed investigation of their potent growth inhibitory activity and feeding deterrence was carried out against variegated cutworms (Koul *et al.*, 1990a). While β-asarone, in addition to inducing sterility was found to be a toxic chemical and α-asarone induced only behavioural effect by acting on the gustatory receptors of lepidopteran insects.

Gross dietary utilization was reduced when the insect diet was supplemented with (β-asarone or when this compound was topically applied to higher stadia of the insects. Inhibition of growth was observed even at a moderate dose primarily as a result of decreased efficiency of conversion of digested food. Oral and topical application of α-asarone also inhibited larval growth significantly but in this case this could be attributed to decreased consumption (Koul, 1995). The data suggested that two asarone isomers have different modes-of-action. β-asarone is toxic, inducing non-specific toxicity through oxidative activation of mixed function oxidases. A generaiistic effect of this compound was confirmed to be due to stable epoxide formation that is apparently able to accumulate in different tissues, albeit dependent on stage and time of treatment. Formation of bioactive epoxide was confirmed by the identification of asarone-epoxide and asarone diol excreted by the insects (Koul *et al.*, 1990b).

NEEM THE ECOFRIENDLY CONCEPT

Ecological interactions in nature suggest a long history of plant synthesized chemical use by insects which have been molded during the course of evolution. These chemicals generally termed termed phytochemicals are often distasteful and toxic to many insects. However, specialist insect herbivores feed on many such compounds, as they are able to process these natural products in a manner that is beneficial to them. From the biopesticidal point of view, phytochemicals do possess anti-insect properties which are either purely insecticidal or act as feeding deterrents, growth inhibitors, growth regulators, repellents, or oviposition inhibitors against a variety of insect species. There are more than 3,08,000 plant species, among which 2400 have been reported to possess pesticidal properties. The pesticidal plants reported so far are distributed in 189 families, among which about 22 families contain more than 10 plant species in each family that, in one way or the other, possess anti-insect properties. These plants are known to produce a diverse range of secondary metabolites such as terpenoids, alkaloids, polyacetylenes, flavonoids, unusual amino acids, sugars, etc. The structure of more than 600 alkaloids, 3000 terpenoids, several thousand phenylpropanoids. 1000 flavonoids. 500 quinones. 650 polyacetylenes and 4000 amino acids have already been elucidated. Many of these chemicals protect the plants from insect pests and pathogens.

Maximum number of pesticidal plants has been reported from family Meliaceae. Among these neem, *Azadirachta indica* A. Juss. has been found to be most promising. Till today 450 to 500 species of insects have been evaluated with neem and 413 of these have been reported to be susceptible at different concentrations. Many commercial formulations of neem are now available in various countries.

My contribution to neem research, in addition to the potential of various neem allelochemicals for pest control in integrated pest management, has been to identify the target site of action of the principal active ingredient of neem, azadircahtin, a tetranortriterpenoid compound isolated from the seed kernel of this versatile tree. We have shown in various studies that neem products have dramatic antifeedant/repellent effect, with many insects avoiding treated crops, Azadirachtin also disrupts insect moulting leading to morphological defects in insects. Interesting part of our work was again to find neem chemicals reducing reproductive capabilities of phtophagous insects by disrupting normal mating behaviour and thereby reducing fecundity. Inhibition of ecdysis also led to effect on vitellogenesis, with the reabsorption of vitellarium and oviducts. Initial studies with azadirachtin effects on endocrine events of lepidopteran insects using injection procedures made us to confirm for the first time that azadirachtin had no direct effect on prothoricicotropic hormone (PTTH) and prothoracic gland secretion using *in vitro* and ligature techniques. To quantify the ecdysone content in each case, ecdysone radioimmunoassay (RIA) technique using antiserum of high reactivity to ecdysone and 20-hydroxyecdysone equally was used. It was also established from our stuides that azadirachtin has more than one site of action in insects and the blockage factors appeared to be situated in the central nervous system and the effect dependent on the balance of developmental hormones at the time of treatment (Koul *el al.* 1987). The compound administered to different larval instars, in subsequent studies, orally, topically or via injections resulted in interference with food utilization and interference with larval moulting and pupation. This led to the conclusion that there is involvement of "aza-sensitive head factor" responsible for the activity. This conclusion was based on the exogenous application of juvenile hormones I and II or juvenile hormone esterase inhibitor (BEPAT, S-benzoyl-o-ethyl phosphoramidothiolate) appearing in the final larval stadium as two distinct peaks of hydrolytic activity. This contributes to the rapid decline in the hormone titre that signals the onset of pupation (Koul and Isman, 1991). The interference with the putative azadirachtin-sensitive head factor being one of the causes of gross azadirachtin effects could induce qualtitative variation in the release of neurosecretory proteins, therefore, a formidable reson for reduction of growth hormone litres (juvenile hormones) was established.

The excretion, retention and tissue distribution of [^{3}H]dihydroazadirachtin was investigated. The candidate compound was rapidly cleared from the haemolymph following either oral exposure or topical administration, with maximum concentration of 6 h post-treatment and peak appearance of label in the frass at 12 hours. However, approximately 45 and 55 per cent of the labeled material was retained in the body of insects at 72 h in respective treatments. Major depots for retained radioactivity were the gut (24% of the administered oral dose, 18.8 % of the administered topical dose) and integument (12.2% of the oral dose and 30.7% of the topical dose). It was obvious from these studies that substantial amount of compound is retained by insect body regardless of the route of administration, suggesting that azadirahtin may be acting in its unchanged form over a long time course (Koul *et al.*, 1994).

Today the commercial biopesticide products are extracted from neem tree seeds and often sold as the crude extract, which contains approximately 1 per cent of azadirachtin, with a recommended use rate of 100-500g AI / ha. The products are quite ecofriendly with low mammalian toxicity with an acute oral LD_{50} to rats of > 5000 me /kg.

FUTURE PERSPECTIVES

There is an earnest need to coordinate research work on biopesticides, viz. botanicals, microbials, biorationals, parasitoids and predators. Proper cataloguing and region wise surveys of natural enemies (parasitoids, predators, pathogens) should be conducted to determine their biodiversity. Within the framework of ecological pest management, making use of plants as biological control agents is providing an important and promising set of technologies. So far, most of the research work has been focused on the rescue and technical validation of a series of these plants and many plants have demonstrated a certain level of efficiency in regulating pests and diseases, and have been proven on the basis of statistically-sound research. However, in case of botanical pesticides different ecotypes show considerable variation in activity and need to be catalogued. Field level studies should be undertaken to evaluate the role of entomopathogens and entomophages in natural control of insects and separate economic threshold levels (ETL) need to be established for biopesticides. keeping in view their slow activity and moderate mortality levels. There is also a need to strengthen research on formulation technology for all groups of biopesticides.

To have focused promotion of botanicals in general, there should be concerted efforts to promote botanicals as an important component of IPM. There is an immediate need to have a systematic protocol for the standardization of products with respect to assurance of quality of botanical biopesticides. This is necessary in view of the origin of botanical products from variable ecological regions.

It is necessary to establish genetic diversity of strains of microorganisms attacking important insect pests through conventional as well as molecular techniques. Use of local materials for mass production of Bt and other microbial products is of utmost importance to reduce cost of production. Isolation of new Bt genes, genetically improved entomopathogenic nematodes, Vegetative Insecticidal Proteins (VIP) and improvement of existing strains should be a continuous effort. Delivery of microbial products is very essential and should be standardized. Production of microbial pesticides should be taken up at the village/block level. This will generate rural employment and also reduce storage and transportation costs. This will maintain the infectivity of these biopesticides, keeping in view their shorter shelf life. Multitrophic interactions involving host plants-insect pests-natural enemies/ pathogens need to be understood in order to manipulate some of these factors in favour of the host plant and to the disadvantage of the pests. We must obtain a clear understanding of the functioning of agro-ecosystem under different environmental conditions. This will help in manipulating the ecosystem in favour of natural enemies. *In vitro* large-scale multiplication of obligate pathogens like insect viruses, protozoans, etc. for the quality production is required. Genetically modified viruses for increased persistence and virulence need a considerable attention. The process of introduction of transgenic crops tor commercial cultivation need to be streamlined after satisfying biosafety measures and should involve other agencies like ICAR, Agricultural Universities, State Departments of Agriculture, apart from DBT. However, while genetic engineering has a place in IPM it should not be considered a panacea for solving all pest problems in future.

Action agency has to convert research data into commercial product or use of research data for rapid development of commercial materials. Identification of techno-commercial personnel for promoting biopesticides is a necessity. Little attention has been paid for weed management vis-a-vis the use of biopesticides. This needs to be strengthened.

Streamlined biosafety regulatory mechanisms and registration protocols need to be established for all major groups of biopesticides that should be less stringent than the conventional pesticides. The establishment and implementation of quality control standards in biopesticides must be ensured. Subsidy should be provided to biopesticide industry and farmers to promote their use in agriculture. The agricultural institutes and state agricultural universities without charging any fees should evaluate the promising biopesticides.

Extension work requires to be geared up among the farming community to make them aware about the use of biopesticides. There should be demonstration plots for farmers where application of biopesticides should be shown to them in order to develop confidence of farmers in biopesticides. Regular meetings should be organized for exchange of ideas and knowledge. In fact, such groups and task forces should be identified to deal with such issues and biotech companies should play an important role in these meetings.

To conclude, biopesticides have come to stay and must be exploited. What is needed is to strengthen our resources and accelerate our endeavours to replace environmentally hazardous conventional chemical pesticides, with these eco-friendly biopesticides.

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CHAPTER 4

PLANT BEHAVIOUR AND ADAPTATION

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The seven criteria of life are, reproduction, response to stimuli, respiration, nutrition, growth, excretion and locomotion. Except the last one, plants by and large obey all other criteria. In this short talk I will briefly comment on three aspects of plant studies with which I have been associated with.

Plants have a unique property called totipotency. This means given the right nutitional mileu and proper physical environment one can produce a new plant from any part of a plant . The first aspect of my research deals with the extension of this phenomenon to pollen grains, to create what we can call as "male plants". What are these male plants? As I mentioned above plants reproduce by sexual means, in addition to vegetative propagation, by the combination of male gametes with the female gametes. The net result of this fusion is the production of seeds. As you know the male gametes are present in the pollen grains. Would it be possible to raise plants only from pollen grains, that is without fertilization and without any help from the female "partner"! I do not wish to sound like a male chauanist or in any way undermine the power of "shakti" but let me tell you that working with a group at the University of Delhi, it was possible to make the pollen grains behave like a fertilized egg and induce these to form full fledged embryos which could be developed into plants. Such plants are called haploid plants and these have great value in plant breeding programs as was shown by many workers later on including Dr. S. K. Raina, of IARI.

The second aspect of my research activity deals with an area of "Sensory Physiology of Plants". Do plants have "senses"? An answer to this question would depend on how do we define this term, senses. We generally relate sense perception with animal kingdom which in turn is related to their behaviour that is governed by the set of "pre-wirings in the brain" and the environment. In most animals, except probably the human beings, the behaviour is intuitive, required for survival and reproduction. If then one accepts the sense behaviour to survival and reproduction than plants fit into this criteria.

Plants are very much alive to their surroundings. They perceive heat, cold, and light and darkness. The perception senses are highly sensitive and accurate. Our own work has been towards determining the mechanisms of light perception and the corresponding cellular responses. Just like our eye can distinguish various colours (infact human eye is so advanced that it can even differentiate various shades of colours), the work from many labs and also ours has shown that plants too can distinguish between incoming red, far-red, blue, green colours. And as in our eye there is a pigment protein complex, called rhodopsin, in plants too a number of photoreceptors are present which continuously monitor and sense the changing light and dark conditions and also the seasonal changes. It has been found that the dark period is very important to plants for many developmental processes like flowering. Does it mean they need to "sleep". In a sense may be, but infact during darkness they keep on performing some very important functions. Some plants are very particular for the duration of their sleep. A few minutes less can disturb their functioning. Or if you disturb the sleep in between even by a minute or two by switching on light, they may refuse to flower. Our work has shown that the photoreceptor which monitors these external environment regulates the production of some very specific proteins in the cells which are required for some metabolic and developmental activities.

In addition to light/dark monitoring, plants also feel the heat and cold, as mentioned above and also respond differently to touch, wind and rain. When you touch the plants they know it and immediately start initiating certain biochemical reactions in the cell. In fact in response to the changing environment they produce certain messenger molecules in cells which bring about required changes. The plant parts also communicate with each other via such chemical messages. In fact we and others have found that this communication could also be mediated via electrical signaling. And we have also found that plants do contain neurotransmitters, molecules that process sense perception through nerves. In short our work relates to an understanding the nature of the photoreceptors, how they generate chemical and electrical signals which are transduced and deciphered and inturn regulate the sensory behaviour of plants.

Plants, like other organisms, are therefore a spontaneous self-maintaing system, sustaining and reproducing itself, executing its genetic program, making a way through the environment checking against performance by means of responsive capacities. Their survival is based on defense strategy and not an offensive strategy. To enumerate a few of their survial and denfense stategy I can say that plants repair injuries, move water and nutrients, generate food material for themselves (and ofcourse for everyone on this planet, they say all flesh is grass), store sugars, make tannins and other toxins and regulate their levels in defense against grazers. It is seen that if some plants are attacked by a pathogen, they release different blends of volatile compounds which are sent as a signal to the other plants in the field, to prepare themselves for the attack by the pest.

Lastly let me tell you the third activity of my research work. It is related to genetic engineering. To some this technology means "playing god".What we intend to do is change the adaptive behaviour of crop plants.

There is a lot of area in India and South Asia that we cannot cultivate—it is saline area. Salinity is caused by a number of reasons one of which is heavy irrigation. This is a price one has to pay for irrigating crops for higher productivity. Nevertheless there are some species of plants that do grow on a reasonably high saline environment. Since genetic engineering technology overcomes sexual barrier and allows the mobilization of genes (these are pieces of DNA, the genetic material in all biological systems except some viruses which have RNA as their genetic material) from one organism to the other, we can take any gene from bacteria, animals, human and transfer to plants to elicit a certain response required for its survival. In one such case, we took a set of genes from one plant and transferred to another and induced these genes to produce more protein than they would have normally made in the cells. The net result of this manipulation was that the recipient plant could now be grown under saline conditions. Once this technology is extended to crop plants it should be possible to grow for example rice in those areas which one cannot cultivate. Many persons are dreaming to extend this technology to usher in an area of sea water irrigation!

Having taken you through a few facets of plant behaviour and responses, can we say plant life is anyway different from other living beings especially animals. Not really if one looks in a broader way at the cellular responses and metabolic functions. But certainly it is a different kind of life. According to shaiva thoughts , there are different states of living beings: Jagrat (awareness), swapan, sushupti (deep sleep) and turia (state of bliss). Human beings have in their swapan mode an ongoing tussle between "sankalp" and "vikalp" Plants do not have any such thought processes going on and according to Abhinavgupta they actually would fall into the category of sushupti. There is feeling from inside but cannot physically express and hence they have a sushupti atman. They cannot physically react if someone approaches to cut them with an axe. This is the same kind of living status as it exists in an egg. An egg cannot also run away if you want to crush it. (This is taken by some persons to declare it as a vegetarian diet). Once the egg hatches, and a chick is born, this now gets into a state of transformed atman. It will run away if you want to kill it. Plants never achieve a state of conscious atman but they have a life and atman of their own kind.

CHAPTER 5

DR. M. J. ZARABI

Dr. M. J. Zarabi (born August 1947) has had a consistently distinguished academic record. Work done by him during his Ph.D. programme represents excellence in engineering research, having provided a good insight into electro-thermal phenomena that occur in semiconductors and semiconductor interfaces. It was for this excellence in engineering research that Dr. Zarabi was awarded the 'Alumni Medal' of IISc., Bangalore towards the best Ph.D. thesis of the year. He has co-authored a book on Electron Devices that gives a unique treatment to the subject and also co-authored an IETE Series book on Microelectronics. Dr. Zarabi has also been honoured with Scientist of the Year Award for 1997 for his contribution in the field of Microelectronics by Gian Chand Jain Memorial Foundation. He is Fellow of National Academy of Sciences, India (FNASc.), Indian National Academy of Engineering (FINAE) and Institution of Electronics and Telecommunication, India (FIETE).

He was among the first few professionals to join and constitute the nucleus of the Information, Planning and Analysis Group (IPAG) of Electronics Commission in early 1972 where, being responsible for the area of Materials and Components, he helped promote a number of important projects in that area. Dr. Zarabi has particularly played a key role in the establishment of Semiconductor Complex Limited (SCL) with which he has been associated from inception having worked on all aspects of planning and execution of the project.

As Head of the Research & Development and later as Executive Director incharge of both R&D and VLSI manufacturing operations at SCL, Dr. Zarabi has launched and led successfully a number of technology development projects of significance from commercial angle as well as for strategic applications. These include development of 3 micron CMOS, EEPROM, 2 micron CMOS, CCD and 1.2 micron CMOS technologies. He has also led the Design Department in successful design and development of a large number of standard and custom/semi-custom circuits for various applications that include Programmable Digital Signal Processors (PSP I in 2 micron CMOS and PSP II in 1.2 micron CMOS), 100 bit x 100 bit CCD Area Array and PCM Encoder for Strategic applications.

With his impressive record of achievements including building and nurturing a strong and bright team of engineers and support personnel at SCL, Dr. Zarabi has not only been a successful leader in high technology but also a pioneer in his own right in launching and guiding a true and meaningful R&D program in industry whereby the organisation has not had to resort to repetitive purchase of technology to remain contemporary and competitive. As Executive Director, Dr. Zarabi was Head of both R&D and VLSI Manufacturing operations at SCL.

Upon taking over as Chairman-cum-Managing Director of the company, Dr. Zarabi has led the company in building a modern VLSI fabrication facility which was dedicated to the nation by the Prime Minister of India in December 1997. His close guidance and all-round support culminated into successful establishment of the processes in the new wafer fabrication facility and commencement of commercial production from this facility in April 1998. Dr. Zarabi has also been instrumental in starting development of several new VLSI products including those for the strategic sector. Under his stewardship, the company also established a facility for GaAs based MMICs for DRDO, which produced the first MMIC in September'97 and continues to develop products for various applications. With active participation of his colleagues, Dr. Zarabi also guided formulation of business strategies and conceived measures to improve commercial performance of the company by identifying new business areas like Electronic Energy Meters, Smart Cards, Telecom products such as Digital Pair Gain System and more recently newer transmission equipment viz., Optimux, Digital Loop Carrier as the products for diversification of the existing Systems products of the company. He took several initatives in seeking joint venture partnership/strategic alliances for the company. He also led the Company in organisational restructuring and development by way of creation of Strategic Business Units, review/rationalisation of rules, policies and procedures resulting in improvement in the performance of the company over the years.

While being synonymous with the microelectronics activity in the country, spearheading both R&D and manufacturing over the last couple of decades, Dr. Zarabi has also been one among those few who have philosphised on the future of microelectronics early on, having been a proponent of Physics-to-Function approach for the next breakthrough in microelectronics. His current research interests consequently lie in Nanotechnology in general and Biomolecular Electronics in particular.

SEMICONDUCTOR COMPLEX LIMITED: A BRIEF

Semiconductor Complex Limited (SCL) has been on the forefront of microelectronics activity in the country. Ever since its inception in 1983 the company has been continually developing process and design technologies through its in-house R&D efforts in the vital area of microelectronics which is at the core of any modern electronic equipment/system. The company has established its name in the field of microelectronics and is an acknowledged pioneer in the country in this field. The company after importing 5 micron CMOS technology in 1983 has successfully developed the next generation 3 micron, 2 micron, 1.2 micron CMOS technology as well as certain specialized technologies such a EEPROM and CCD for imaging application. More recently, SCL has successfully established the 0.8 micron CMOS technology at its re-built class 10 water fabrication facility. Having indigenously developed process and design technologies and demonstrated the same through development of products for different market segments, the company has build an expertise in the country to develop newer technologies/products to fulfill the strategic needs of the country in this vital area of microelectronics. The company has selected a niche market in India primarily addressing the requirements of the Telecom, Industrial sector as well as *Application Specific Integrated Circuits (ASICs)* and Application *Specific Standard Products (ASSPs)* for different market segments.

SCL's vertically integrated semiconductor operations offer *Design, Wafer Fabrication, Testing, Packaging, Quality Assurance & Reliability Testing as well as board/system level assembly.* Since

1984 the company has been supplying a variety of key Very Large Scale Integrated Circuits (VLSIs) to the Telecom, Industrial and Strategic sectors. The board/system level products supplied by SCL include Digital Pair Gain System, optimux range of products for the telecom sector, boards for water purification system and certain other professional boards.

Among the newer business areas identified by SCL are the *Electronic Energy Meters (EEMs)* and *Smart Cards*. SCL's EMMs best know for their high accuracy and tamper proof features are being supplied to various State Electricity Boards in the country. The company is also making efforts to become a major player in the country in the areas of Smart Cards for applications such as ID, driving license, PDS, payphone, access control etc. Given its experience and expertise in the manufacture of chips/micro-modules and infrastructure particularly chip fabrication, SCL is uniquely positioned to manufacture smart cards for the various applications in the country.

In keeping with its corporate mission of leading India's effort in the important area of microelectronics, SCL has embarked upon *'India Chip Programme'* which programme is aimed at providing opportunity to IC Designers to see their designs through to the fabrication stage while providing in-expensive prototyping solution by cost sharing. The programme essentially entails starting multi-product wafer runs at regular intervals at SCL by putting different circuits from various designers on the same mask set/wafers, thereby reducing the cost of prototyping per design. The programme envisages to play a key role in enhancing the IC design activity, particularly in the generation of IP blocks in the country. Supplementing the *'India Chip Programme'* and effectively contributing in manpower development in area of VLSI Design is a comprehensive *VLSI Design Education and Training* (VEDANT) course introduced recently by SCL which covers complete spectrum of VLSI Design activity both Front-end and Back-end and provides exposure to the IC fabrication process. This six months course designed for engineers and postgraduates in Electronics/Physics has been started at Mohali and Bangalore in Dec. 2001 while plans are afoot to gradually expand this activity to other major cities as well.

The authorized *share capital* of the company is *Rs. 200* crore and the *paid-up share capital* is *Rs. 188.415* crore. The company has been improving its commercial performance both in terms of sales turnover and profitability level. The company clocked a revenue of Rs. 66.28 crore during 2000-01 against Rs. 58.45 crore during 1999-2000 and posted cash profit of Rs. 3.00 crore during 2000-01. The target for 2001-02 is about Rs. 72 crore which the company expects of achieve.

Form making chips to providing total solution SCL is a one stop microelectronics organization. The company also offers a whole array of services that include foundry, deisgn, testing and packaging services. Fully geared to meet the ever increasing challenges, the company is poised to attain greater heights in the microelectronics field placing India on the global microelectronics map.

CHAPTER 6

Prof. D.P. Zutshi

Visiting Professor, Jawaharlal Nehru University, New Delhi

At the outset I like to thank the President and the members of the Kashmir Education Cultural and Science Society for inviting me to this seminar. I deem it to be an honor to make a presentation of my work before such an august gathering. I am an ecologist and my field of interest is aquatic ecology, especially studies of lakes and wetlands of Himalayan region. I shall try to highlight only the major contributions of our investigations because it is just not possible to cover the entire period of nearly four decades.

During the early sixties, (1964-68) we began ecological study of aquatic lakes and marshes of Kashmir valley at the University of Kashmir. It is interesting to note that at that time only two major centres of ecological research existed in India, the one at BHU was mainly involved with Grassland and Forest ecology and the other at the Royal Institute of Science, Bombay University investigated Phytosociology of grasses and nitrophilous plants. There were also a couple of small groups working on traditional ecological problems such as desert ecology etc. Our group is one of the pioneers in initiating researches on Himalayan lakes.

In the beginning we investigated species composition, distribution, phenological cycles and life-form spectrum of aquatic macrophyte vegetation. Studies were also undertaken on ecological features, genesis and development of floating islands and their role in socioeconomic life of the ecosystem people. Investigations on morphometry, transparency, thermics, sediment and water chemistry and structure of aquatic plant communities were also taken up. A new classification was introduced for delimiting aquatic associations and their habitat preferences. These studies constituted base-line data for evaluation of aquatic biodiversity and possible use of floating islands as traditional management tool.

With the launching of IBP, production ecology overtook other branches of ecological research and same was the case with aquatic ecology. During late sixties and early seventies considerable amount of data was generated on standing crop, bio-mass production and seasonal variations of aquatic plants.

In autumn of 1968 I left for Europe to work at the Institute of Hydrobiology, Pallanza and at the University of Amsterdam. Besides familiarizing myself with recent developments in the field of limnology I worked on phytoplaknton photosynthesis, algal dynamics and trophic status of Lago de Mergozzo that was later published in the form of a monograph by the Institute.

On my return in 1970 I joined S.P. College, Srinagar and initiated field and laboratory studies on Salvinia natans, an abnoxious exotic water fern. Although some measures for its control were suggested the State Government did not take any immediate action with the result that today Salvinia has threatened the very existence of many water bodies in Kashmir. Simultaneously we initiated studies on the ecology of high mountain lakes situated beyond 3500m altitude. These unique ecosystems have simple trophic structure, plankton species are adapted to short growing period and high levels of UV. Many zooplankton species were observed to develop pigmentation to offset the effects of intense radiation. A few endemic species were observed to survive under very harsh environmental conditions. For measurement of phytoplankton production more accurate methods of C-14 uptake and chlorophyll a concentration was used.

In recognition of our work, the UGC, CSIR and the State Government provided funds to enable us to establish a Hydrobiological Research Laboratory in S.P. College which was recognized by the Kashmir University as a centre for M;Phil and Ph.D research on the recommendations of the visiting UGC team. The Lab. continues to function even today and is doing good work especially in the field of rehabilitation ecology and ecosystem monitoring. Perhaps this is the only case where an undergraduate college is allowed to admit Ph.D scholars for research degrees.

Towards the end of 1975 I went to work at the Austrian Academy of Science, Vienna. Studies were carried out Lunz am See during 1975-76 to assess the suitability of using periphytic populations as biological monitors of pollution. The results of these investigations were included in OECD document.

While I was still in Austria I received a letter from the Chief Secretary, J& K informing that the Government has constituted a State Board for Ecology & Environment with Chief Minister as its Chairman. I was invited to be a member of the Board. The Ist meeting of the Board was held in Jammu in Feb. 1977. I presented a brief report on the state of environment in J & K. The Board took some important decisions which included inviting ENEX of New Zealand under ODA for preparing a project report on pollution of Dal Lake and measures to control it.

Our efforts to make State Government aware of the extent of pollution of aquatic ecosystems were slowly but surely bearing fruits. This was the time when the local press carried many stories about the consequences of environmental degradation. People became aware of the dangers of pollution. A few environment groups were constituted by local people.

We extended our research and investigated two beautiful lakes, Mansar and Surinsar from the Siwalik region of Jammu. The ONGC had started drilling for oil in the vicinity of Surinsar and we undertook a study to assess the impacts. The results showed significant ecological changes in Surinsar lake in comparison to Mansar where human impact was negligible.

The decade starting with 1980 (By that time I had already shifted to the Kashmir University), was the most productive period for us with the MOEF and the UGC providing liberal research grants. The focus of our studies shifted to energy flow through ecosystems and efficiency of different trophic levels under varying climatic conditions. The lake sediments were investigated for clay mineralogy using XRD and DTA (differential thermal analysis). The ionic activity product and equilibrium constant of calcium and carbonate ion for ambient water was used to trace the origin of calcite in lakes. Data on load tolerance model incorporating mean depth, flushing rate and concentration of phosphorus was used to determine the degree of eutrophication. Rapid bioassay techniques were used to assess the critical ranges of various nutrients. Periphytic populations from natural and artificial substrates were used to monitor pollution levels. On our recommendations the department of environment was established by the State Government During mid-eighties collaborative research was undertaken with BARC, FBA, U.K., Space Application Centre, Ahmedabad, National Physical Laboratory, Ahmedabad, Department of Soil Conservation and UEED, Srinagar. We got opportunity to present our findings at various National and International conferences and symposia including International Congress of Ecology, International Biomanipulation meeting, International Conference on Shallow Lakes, SIL Congresses, International Rotifer Conference, and many others meetings.

In 1990 we received funds from INSA and the State DST to work on invasive species and monitor the impacts of Dal Lake Development Programme. We had just started the projects when I had to leave Srinagar and shift to Jammu. This was most trying time for all of us. All my books, journals, data files, notes and everything else was left behind. I was lost in wilderness. I went to Chandigarh, applied to the UGC for a National Fellowship that was soon awarded and thus a new phase started in my life. I continued in P.U as a visiting faculty. During this period quite a few papers were published on the impact of Biomanipulations, periphytic rotifers and impact of tourism on aquatic ecosystems. The UNEP awarded travelling Fellowships to enable me to present my research work at International meetings. The H. P. and Panjab Governments appointed me on their State Council for Ecology and Environment and State Board on Biodiversity. I got an opportunity to visit many lakes in H.P and recommend measures for conservation.

In 1998 I shifted to Delhi and joined as UGC Emeritus Fellow in SES, JNU. Since then I have been involved in studies of Trans-Himalayan lakes, Aquatic Biodiversity changes, Ecosystem health and we are also writing a three volume synthesis of the studies undertaken so far on the Lakes and Wetlands of Himalayas. I was nominated to the Board of Directors, JK Lakes & Waterways Development Authority . I was also involved in preparing a DPR on

Dal Lake commissioned by the MOFE through the University of Roorkee (now IIT).

It is a matter of satisfaction to note that today there are numerous groups and centres involved in lake, wetland and river studies in India. Aquatic ecology has come of age and has carved its own niche within the realms of Indian Ecology. On lakes and wetlands of Kashmir Himalayan region more than 400 research papers, about 100 dissertations , numerous project reports and articles have been written.

Before I conclude I would like to quote following lines from Mark Twain, "When I was younger I could remember anything, whether it has happened or not, but my faculties are declining now and soon it shall be so I cannot remember any but the things that never happened".

Thank you for your attention.

CHAPTER 7

SCIENCE POLICY IN INDIA

Talk by J. Dhar

Emeritus Prof. CSIR New Delhi

Preamble: The subject of this talk, "Science Policy in India", is wide in its range. Owing to the time available and other considerations, I shall be able to provide only an overview of its salient features. In doing so, I may not be necessarily following any definite chronological order.

At the time of Independence, the Indian policy makers were aware of the dual role that promotion of science and technology could play in the country. It would, on the one hand, contribute to filling in the wide gap that existed in the state of knowledge of modern science in India, and also simultaneously play a vital role in accelerating the future industrialization of the country. This was evident from the historic changes that had taken place in Europe during the preceding four hundred years or so. Advancements in science and technology had a major impact on the growth of industry and the consequent economic revolution that took place in the Western World. It was also clear that if science and technology were to propel changes for improving the socio-economic conditions in India, it would be essential to formulate appropriate policy guidelines for the various sectors in which S&T could play a catalytic role. Therefore, when the task of preparing national plans was undertaken, science was given a significant place.

2. During these crucial years, the commitment to science was evident from several initiatives taken by the Government. The

setting up of the laboratories of the Council of Scientific and Industrial Research (CSER) was commenced under the charge of Dr. Shanti Swamp Bhatnagar; the Atomic Energy Commission was established, and Dr. Homi J. Bhabha was nominated Secretary, Department of Atomic Energy in 1954; Defence Rresearch and Development Organisation (DRDO) was set up (1958), and Prof. Daulat Singh Kothari was appointed its Director General as well as Scientific Adviser to the Ministry of Defence. It should be noticed that the Government was involving eminent scientists in developing and shaping some of the country's premier programmes. Reference should also be made to the establishment of the University Grants Commission (UGC) in 1956, which greatly influenced the expansion of teaching and research facilities in our universities.

3. These and other developments led the Government to take a closer look at the S&T apparatus, in order to make it more effective. There was a need to formulate a National Science Policy, for assessing the country's R&D efforts, defining objectives and priorities for promotion and utilization of S&T, and coordinating research in different sectors along with the requirements of trained manpower, to maximize the benefits achievable from expended resources. The Science Policy also stimulates thinking and action relating to future research and technological needs of the country.

4. Perhaps it would be appropriate to quote here the words of India's first Prime Minister, Jawaharlal Nehru, who once remarked, "You must consider science and the spirit and temper of science as important. If they are important, then they should be given an important place in your political, economic and social structures. Facilities should be given for the advancement of science and scientists and universities, wherever this work is done. And, the scientist should be duly honoured and not considered some kind of camp follower..."

5. These thoughts were explicitly expressed in the Government's "Scientific Policy Resolution", announced on 4th March 1958. To quote some of the aims of this policy, "to foster, promote and sustain the cultivation of science and scientific research in all its aspects - pure, applied and educational;

"to ensure an adequate supply of research scientists of the highest quality, and to recognize their work as an important component of the strength of the nation;

"to encourage, and initiate programmes for training of scientific and technical personnel, on a scale adequate to fulfill the country's needs in science and education, agriculture and industry, and defence; and

"in general, to secure for the people of the country all the benefits that can accrue from the acquisition and application of scientific knowledge."

The Government had decided "to pursue and accomplish" the stated aims by "offering good conditions of service to scientists and according them an honoured position, by associating scientists with the formulation of policies, and by taking such other measures as may be deemed necessary from time to time". This resolution continued to reflect the essence of the policies of the Government during the subsequent years, subject only to variations arising from the changes in the political outlook at the Centre.

6. The Scientific Advisory Committee (SAC), which had been set up to advise the Cabinet on the "formulation and implementation of the Government's scientific policy", was replaced in 1968 by the Committee on Science and Technology (COST), with broader terms of reference, which included technology as well. It may be mentioned here that the Government not only supported the growth of S&T in the country, but was also keen to ensure the establishment of a proper institutional mechanism with it.

7. In order to discuss measures for the implementation of Scientific Policy Resolution, the Government convened three Conferences of Scientists, Technologists and Educationists during the years 1958 to 1970. The Third Conference, held in November 1970, addressed four topics, namely, Science Policy, Climate of Science and Management, R&D in Industrial Development, and Higher Education and Manpower. I am deliberately mentioning the topics of this Conference, in order to indicate the range of thinking of the Government, involving science, education, industry, management, R&D and manpower development in an integrated manner. This Conference regarded the Scientific Policy Resolution

to be an admirable document of the Government's faith in science and its role in transforming our society.

8. The next important step taken by the Government was the establishment of a National Committee on Science and Technology (NCST) in 1971, for preparing an overall S&T Plan. NCST acted as an advisory body to the Government on matters relating to S&T and had the important mandate of preparing and updating the national S&T plans as an integral part of the socio-economic plans. In formulating the first S&T plan, a sectoral approach was adopted, identifying 24 major sectors. Important features of this exercise were (a) putting as much emphasis on the development of engineering, design and fabrication skills as on the development of process/ product technology; (b) making the existing S&T infrastructure more effective through the provision of additional facilities, rather than creating new organizations; and (c) emphasizing rural development. With regard to basic sciences, a number of mechanisms were suggested to support research in higher educational institutions. The result of these efforts, during 1972-73, was an important document, which reflected the needs of the various sectors, thrust areas, and possible avenues for extending our S&T skills.

9. This brings us to about the midway period since the time of the Independence in 1947. A great deal of effort and serious thinking had gone into evolving a viable base for the growth and promotion of S&T as a vital domain of our country's progress and advancement The subsequent three decades were equally remarkable in a somewhat modified manner. Although this period was not characterized by an assured and uninterrupted political patronage, the Government machinery and the zeal of our scientific community made it possible for the S&T scene in the country to grow administratively, institutionally, and manpower-wise on the one hand and in terms of an extended policy framework and achievements in different branches of R&D on the other.

10. An apt example of the evolution in the Government's approach was the enunciation of its "Technology Policy Statement" in 1983, made twenty-five years after the Scientific Policy Resolution. Recognising that "in a country of India's size and endowments, self-reliance is inescapable and must be at the very heart of technological development", this document encapsulated the

guidelines for "the development of indigenous technology and efficient absorption and adaptation of imported technology appropriate to national priorities and resources." I would only like quote the following paragraph from this worthy document, which is relevant to the theme of this talk: "Our task is gigantic and calls for close coordination between the different departments of the Central and State Governments and also those concerned, at all levels, with any sector of economic, scientific or technological activity, and, not least, the understanding and involvement of the entire Indian people. We look particularly to young people to bring a scientific attitude of mind to bear on all our problems."

11. The vision of growth in science and technology was entering its next phase in the nation's determined effort to put in place appropriate administrative bodies and R&D establishments, for addressing the future programmes envisioned by our S&T planners. Formulation and implementation of the various policies and action plans, were reviewed by the apex level bodies that were from time to time constituted by the Government. Besides the ones I have already mentioned, the others included

- The Science Advisory Committee to the Cabinet (SACC), 1981-86; and
- The Science Advisory Council to the Prime Minister (SAC-PM), 1986-90.

12. These major initiatives included the setting up of some new departments. The Department of Electronics (DOE) was established in 1971, the Department of Science and Technology (DST) in the same year, and the Department in Space (DOS) in 1972. Four more Government agencies came into being during the 1980s, namely, the Department of Environment in 1980, which was later converted into the Ministry of Environment and Forests in 1985; the Department of Ocean Development in 1981; the Department of Non-Conventional Energy Sources in 1982, which was upgraded to the Ministry of Non-Conventional Energy Sources a decade later; and the Department of Biotechnology in 1986. Towards the end of 1990s, the Department of Electronics, National Informatics Centre, and Electronics and Software Export Promotion Council were merged to create the Ministry of Information Technology (MTT) in 1999.

13. To these and the agencies that were mentioned at the beginning of this talk, namely, CSIR, Atomic Energy, UGC and DRDO, we should also add the two of the older organizations, that is, the Indian Council of Agricultural Research (ICAR) and the Indian Council of Medical research (ICMR). Reference should also be made to the important rote played in the field of Technical Education, by the All India Council of Technical Education (AICTE) which, like the UGC, is a statutory body set up in 1987 by an Act of Parliament. All these departments, organizations, and statutory bodies act in accordance with their respective mandates. They function autonomously, or, in coordination with each other or other concerned agencies of the Government, which have not been mentioned in this talk.

14. While talking about India's S&T policy, reference should also be made to the component of our research and development programmes that is a product of the country's bilateral dealings with other nations of the world, as also its participation in the affairs of the various agencies of the United Nations and other international bodies. Under bilateral programmes of cooperation, mutually agreed upon activities .are formulated and undertaken in collaboration with researchers and scientific institutions of the other countries. Such interactions, generally, take place under the umbrella of the agreements of S&T cooperation, which have been concluded between the Government of India and the Governments of other countries. The areas of bilateral interest and the terms of cooperation vary from country to country.

15. These initiatives have played an important role in establishing fruitful bridges with the administrative and institutional arrangements prevailing in other nations. India has gained through various kinds of interaction in different branches of science and technology with scientifically and industrially advanced countries. Our country has, in turn, been of assistance to scientifically less developed nations. This has been possible on the basis our own experience and range of development activities in different spheres of economic and technological growth. In this process, situations have also arisen when differing governmental policies have influenced the choice of possible areas in which interaction was possible. Issues relating to intellectual property rights are a case in point.

16. We have so far talked about the policies of the Government and the setting up of the various departments and organizations, in order to fulfill the stated objectives of scientific growth and technological advancement. No reference has so far been made to the size of the financial resources made available for the implementation of the various R&D programmes, or to the adequacy of the amounts made available by the Government, or, for that matter, to a comparative assessment of the degree of actual overall progress made. These are not easy questions to answer, but we shall attempt to provide some figurative ideas in this regard.

17. During the 1980s, the Government actively examined possible measures that could enable it to raise the quantum of funds needed for the implementation of the various R&D programmes. The R&D funding was about 0.92 percent of our GNP (Gross National Product) in 1990. This amount, however, did not remain steady, and fell to about 0.70 percent of GNP in the year 2000. How do we stand *vis-a-vis* other countries in the world? In the industrially advanced nations, the corresponding figures are in the range of 2 to 3 per cent of GNP, and in the countries of East Asia, 1.5 to 2.5 per cent. This resource constraint has obviously acted as an impediment in various ways, on the nature and extent of our technological progress as well as its appropriate dovetailing with the relevant aspects of our industrial programmes.

18. While making these financial assessments, it should also be noted that more than 55 percent of the country's allocation for R&D is made for the establishments of Atomic Energy, Defence and Space. Only the remainder amount is thinly distributed for R&D in the wide range of areas in the civilian sector. This situation obviously points to the need for enhancing the extent of our financial resources, and a revision of the policies to raise these funds as well as their sector-wise utilization. This would imply altering some of our conservative concepts of planning as applied to S&T enterprise, resource mobilization, and overall accountability. For one thing, it is apparent that the process of research and development activities being undertaken jointly by the Government sponsored and privately funded arrangements should be escalated. And, the implementation of these projects should be tuned' to the influence of the market driven forces, to make them both competitive as well as price-worthy.

19. While making these observations, I am indulging in some loud thinking. Yet, the figures in our R&D statistics have been telling us emphatically that there is an urgent need to modify and restructure certain facets of the existing linkages between our research and development efforts and industrial projects. These need to be fine-tuned to certain other nuances that play a key role in converting a new invention or a discovery into a readily saleable product or process. These are not mere theoretical conjectures. The rapid progress made by a number of countries, whose techno-economic profile till some years ago was not significantly different from our own, is indeed a matter to ponder over. We may pat ourselves for the transformation that has been brought about during the past fifty years and, no doubt, a great deal has been achieved. We may also provide reasons for the shortfalls that are staring us in the face. Yet the truth remains that besides addressing our indigenous socio-economic issues, India has also to emerge as a competitive techno-economic nation, which is adequately equipped to face the growing global challenges around us.

20. This brings me to the conclusion of my talk. In this synoptic overview, I have projected the perceptions of the leaders of our country from the time of India's Independence onwards, and have given expression to the wide-ranging steps taken by Government in executing these ideas and shaping fresh directions of our scientific policy. I have also expressed an urgent need for reviewing and restructuring the manner of executing future techno-economic initiatives in the country. Let us not forget that Gene Cloning on the one hand and TRIPS on the other, connote the signposts of the times to come. Thank You.

40530

CHAPTER 8

ABSTRACT OF ADDRESS TO THE INDIAN SCIENCE CONGRESS - 1986

Dr. (Late) T. N. Khoshoo

I. Historically we have been serious minded about environment and the basic philosophy has been one of the *harmony* with nature as against western concept of *conflict* with nature. We followed the latter during the last 150 years or so.

Why back in 1957, when environment was not even talked about, we wrote: "We have many large scale river valley projects which are carefully worked out by engineers. I wonder however, how much thought is given before the project is launched, to having an ecological survey of the area and to find out what the effect would be to the drainage system or to the flora and fauna of that area. It would be desirable to have such an ecological survey of these areas before the project is launched and thus avoid an imbalance of nature".

Time has come when sustainability in development has to enter in our planning process as one of the basic and permanent objectives.

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*Prepared by Prof B B Dhar, Vice-President, KECSS for the Seminar on Science and Synthesis, April 7, 2002.

II. Twelve areas have been identified where priority action is needed. In fact these would also constitute important steps towards sustainable development itself.

1. Population Stabilisation
2. Integrated Land Use Planning
3. Healthy Cropland and Grassland
4. Conservation of Biological Diversity
5. Control of Pollution in Water and Air
6. Development of Non-Polluting Renewable Energy Systems
7. Recycling of Wastes and Residues
8. Ecologically Compatible Human Settlements and Slum Improvement
9. Environmental Education and Awareness
10. Updating Environmental Law
11. New Dimensions to National Security
12. General Considerations

III. Four important issues of policy nature have emerged from the actual work and working at the Centre and in the States as also discussion of environmental issues in this address. These are :

1. The plans for environmental management should be integrated in all the developmental activities of all sectorial authorities (from a Ministry/department/ development agency/ corporate body/municipal council down to panchayat) who have the primary responsibility for environmental protection. Implicit in this statement are the following points :

- A mass education and awareness programme from primary school children to professionals, policy and decision makers and everyone in between.

- The Department of Environment at the Centre and in the States have to perform a "Watch Dog" Role and clubbing it with other Departments would be counter productive, because it treads on the toes of each and every sectorial authority. The Department should act as a catalyst, an Agent of Change and a Systems Builder.

- Key to the success in environment lies in cooperation between Central and State governments, their subsidiary agencies, financial institutions, non-governmental bodies, etc.

- Environmental management (including Impact Assessment) should be a statutory obligation for all developmental projects.

2. Programmes on environmental amelioration (improvements) can succeed only when participation of public is secured and ensured and public at large develop a stake in environment.

3. A strong S and T base is needed for environmental research and development, education and training and demonstration and extension.

4. Mechanisms need to be strengthened for ensuring :

   - Corrective or curative or restorative action with regard to environmental damage that has already taken place. An example of such action is Mission on Ganga.

   - Preemptive action regarding the envorinmental damage expected from the future developmental activities and thereby insulating the country from further damage.

Suggestive Recommendations: The principles of environmental management will have to be applied to all developmental activities. Inherently, environmental management is interdisciplinary and inter-departmental/ministerial in character.

1. The most urgent and pressing problems for the consideration of such a body would be the preparation of the National Conservation Strategy (NCS), not only involving Governmental channels but also Non-Governmental Organisations.

2. The recommendation of the Tiwari Committee about appointing well-trained and well-informed Environmental Advisers in all the Ministries needs to be activised at the earliest.

3. A policy research and training institute on the management of environmental needs to be established to look after the training needs for Environmental Advisers as also take up work on some of the policy issues outlined above.

4. Special attention needs to be paid to the rehabilitation of Himalayas and work of Himalayan Institute on Environment and Development needs to be expecdited as a Network Institute.

CHAPTER 9

Pharmacy As A Career

Prof. Roop K. Khar

Jamia Hamdard, New Delhi

Health care is one of the most vital functions in the society. One of the most important aspects of health care is the development, manufacturing and distribution of medicines. Pharmacists play this Pivotal role in the society.

Pharmacists study the compositions and functioning of different drugs. They test the drugs for effectiveness and safety and note the side effects. Other than understanding the use and assignment of drugs and medicine, Pharmacists also keep detailed records of Patients use, are they hurting themselves by taking extra doses etc. Pharmacists need to make the customers comfortable in their presence, they should be ready to talk Pharmacists.

Scientific advances in medicine have been a blessing since all the treatments and methods to prevent of diseases are now widely available. The daily discovery of more and more new drugs and drug treatment options has created bigger demands for Pharmacists, who can consult Physicians and healthcare practitioners on the proper use of there new drugs.

India has vast and growing Pharmaceutical industry. With the implementation of the WTO proposals on intellectual property rights, Indian companies will have to increase their focus on Research and development of new medicines. Indian companies have also started exporting bulk drugs and Pharmaceuticals.

On the other hand Indian Population is ever increasing and is still laggard in the field of health care with basic health care not readily available to all. All these factors indicate that Indian health care industry has a longway to go and Pharmacists have to play a vital role in it. Apart from being a Pharmacist with new academic work they can move into Pharmacology or become Pharmaceutical chemists. Those who are academically minded, combine Pharmaceutical and legal education to persue jobs and patent lawyers or consultant on Pharmaceutical and drug laws.

In the coming years there will be increasing demand of qualified Pharmacists in all sectors namely research, manufacturing, marketing and retail various avenues available in the profession of Pharmacy are given below. Pharmacy is an exciting career and becoming increasingly popular among boys and girls. The following undergraduate and Postgraduate courses are taught in different Indian universities.

(i) Diploma in Pharmacy (D. Pharm.) a 2 years course after 10+2.

(ii) Bachelor in Pharmacy (B. Pharm.) a 4 years course after 10+2. Lateral entry into the B. Pharm. course in the second year is available after completing Diploma in Pharmacy.

(iii) Master of Pharmacy (M. Pharm.) a 4 semester (2 years) course is available in seven main specializations i.e. Pharmaceutics, Pharmaceutical Chemistry, Pharmacology, Pharmacognosy and Phytochemistry, Quality Assurance, Pharmacy Practice and Pharmaceutical Biotechnology.

(iv) Doctor of Philosophy (Ph. D.) in Pharmacy in respective specialization.

Pharmacy is the art and Science of preparing and dispensing medications and the provision of drug related information to the public. Pharmacists is an educated and trained personnel in the field who make and dispense drugs and provide valuable drug information as a member of health care team. The numerous career opportunities available to them are;

1. Industrial

Working for Pharmaceutical companies can be highly rewarding and professionally satisfying. Various opportunities for employment in the industry could be as follows.

(a) Medical Representation

Multinational and indigenous drug companies employ Pharmaceutical graduates for promoting their products. Success in this career depends upon personality, communication skills, relationship with Doctors and other health care team members.

(b) Pharmaceutical Manufacturing

B. Pharm. graduates are employed in Pharmaceutical production of tablets/capsules, liquid orals, ointments and suppositories or in the production of injections and eye drops. After an apprenticeship period of 18 months they are approved as manufacturing chemists as per the Drugs and Cosmetics Act, 1945.

(c) Quality Assurance/Quality Control

This is a very important activity. The drugs are required to be safe, effective and of good quality. Quality of the drug is built in by following Current Good Manufacturing Practices (CGMP). Finished dosage forms are analyzed according to Pharmacopoeial or other procedures to ensure that they confirm to established quality standards.

(d) Research and Development

Discovering of new drugs, new dosage forms, new procedures for manufacturing, discovering new chemical utilities, finding new usage for existing drugs or developing new analytical methodology are some of the activities, performed by the Research and Development department. M. Pharm., or PhD's. are employed for this purpose.

2. Community Pharmacy

This is the career opportunity for most D. Pharm. and some B. Pharm. graduates

(a) Retail Pharmacy

Provision of Pharmacy services at retail counters is the professional service a pharmacist performs. The pharmacist is involved in purchasing, storing and proper dispensing of medicines.

(b) Hospital Pharmacy

In the hospital environment the pharmacist is involved in providing drugs for out-door patients and for supply of drugs to in-patients in wards. Interaction with patients, nurses and doctors is often necessary to give drug related information on its proper use, dosage, interactions, contra indications and side effects. Economic purchase of drugs and proper storage is a vital component of a hospital pharmacist's job.

3. Job's in the Government

Central and State governments employ pharmacists as drug inspector for licensing and control of sales premises as well as approval and licensing of manufacturing premises. Continuous monitoring of sale and manufacturing premises is done by drug inspectors.

Drugs analysts are also employed by the government in various laboratories to perform analysis of drug samples.

4. Teaching/Academics

With the continuous expansion of Pharmacy education, there is an increasing need for qualified teachers. The teachers as required for Diploma institutions in Pharmacy as well as for institutions providing B. Pharm and M. Pharm. courses. M. Pharm. and preferably Ph. D. degree is required for appointment as Lecturer.

5. Higher Studies Abroad

Increasingly large number of B. Pharm. and M. Pharm. graduates proceed to USA, Canada and European countries for further education. Many students obtain research/teaching assistantship to partially pay for foreign education.

6. Self Employment or Business

Graduates in Pharmacy with entrepreneurial skill can start manufacturing units as well as testing laboratories. Some pharmacists can become consultants and provide expertise for setting of new pharmaceutical units and solving of formulation problems.

7. Pharmaceutical Journalism

Pharmacy graduates with excellent communications skills have started magazines, journals and newspaper providing information about developments in the field of Pharmacy and medicine.

8. Regulatory Authorities

The pharmacists can take up jobs in the regulatory affairs department of various medium and large scale pharmaceutical industries.

9. Clinical Research

The Pharmacists can be a member of clinical research team in hospitals and other institutions

10. Opportunities in allied Career after B. Pharm.

- Biotechnology, B. Pharm. + M. Tech./M. Sc. In Biotechnology
- Pharmaceutical Marketing, B. Pharm. + M.B.A.
- Patent attorneys, B. Pharm + L.L.B.(New opportunities)

CHAPTER 10

EVOLUTION OF MEDICAL PRACTICE IN KASHMIR AND ROLE OF KASHMIRI MEDICAL SCHOLARS

Prof. Dr. Shakti Bhan Khanna

The great mountain ranges around Kashmir have until recent times greatly isolated it from rest of the world. This isolation has at all times exercised a decisive influence, not only on the history and people of Kashmir, but their traditions, day to day living with minimal effect from the outside world. But with advent of time, the communication with outside world improved and with many invasions from outside world, from north, south and west of Kashmir, the traditions too started changing in Kashmir and so was its impact on thinking of people, life style etc.

Many a historian has from even ancient times tried to write the history of Kashmir. The famous Raj Tarangini doesn't only write about the kings of Kashmir, but also about those of its neighboring countries. Alas, most such history books write only about the kings and their courts; no historian has written about the people, their struggles, aspirations and successes. So if one were to look for the evolution of medical practice in Kashmir over the ages, one has just to be content with occasional references in a few books mainly in travelogues of Chinese, Central Asian and European travellers to Kashmir.

ANCIENT TIMES

Like in many parts of the world, the medical practice in Kashmir has undergone a sea change over the ages. Owing to rich flora and fauna in the valley, a number of traditional systems of medicine like Ayurveda, siddha, yoga and Naturopathy were practiced in ancient times. Rigveda is the celebrated treatise, mentioning the use of some medicinal plants. During the Vedic period only vegetables were used. In Pre-Buddhist period, *Agnivesha* and *Susruta* wrote their treatise on medicine and surgery, which were recast by *Charaka* and *Nagarjuna* respectively. In Puranic period, *Drdhuvala* improved and enlarged *Charak's* edition. *Charak* and *Sushruta* were supposed to have been living around 1000 BC. According to Prof. Sylvan Levi, *Charak* of Charak Samhita was a Kashmiri pandit. He came to this conclusion after discovering Buddhist manuscripts in central Asia and China. *Drdhuvala* was a native of Pancanadapura, a town of Kashmir (Hoerule's 1907). *Jejjata*, the author of the commentary on *Charak's Samhita* was also a Kashmiri scholar and so were the *Vagbatta* and *Udbhatta*, who commented on Susrusamhita. (Mukhopadheya 1922).

According to Kalhana, *Vasunanda*, a king of Kashmir wrote a book on erotics. *Ratrirahsya*, a scientific book dealing with problems of sex was written by a Kashmiri pandit *Koka*, son of Tejoka. This book is a very important work on the subject after Kamasutra written by *Vatsayana*. *Kalyanmalla*, author of Ananga Ranga and *Kuchi Mara*, the reputed author of Tantra were both Kashmiris. King Jayapedas' minister *Dhamodhar Gupta*, wrote an excellent treatise in verses on the ethics of concubinage in the book Kuttainmata Kavya.

MEDIEVAL TIMES

Islam came to Kashmir in the year 1320 - 23 AD under the rule of its first Muslim king Rinchin. With Islam came the Unani and Tibb system of medicine. So, in medieval times i.e.; 1339-1879, these systems were practiced in Kashmir along with Ayurveda. The historians have mentioned the names of only two pandits Physicians in these times namely *Shreya Bhat* and *Yavaneshwar*. *Shreya Bhat* was the court physician of Sultan Zain-ul-Abidin. This great physician cured the king of a serious poisonous boil in forearm and when king asked him to name the reward, Shreya Bhat - the humane man only wanted all the restrictions imposed on Kashmiri Pandits by Sikandar, the Iconoclast including the tax (zajjia) to be removed. In Zain-ul-Abidins times, there were many hospitals in Srinagar and large towns of Kashmir. One also finds the name of another physician *Yavaneshwar*, in the year 1484 AD, who was respected and honored by all Kashmiris, but was killed by Sayyids, when they conquered Kashmir. (Dutta, 1993)

In Kashmir, the practice of medicine was usually a hereditary profession. The medical knowledge of Vaids and Hakims was based on herbs, ayurveda and a scraping acquaintance with Greek system of medicine. The agriculturists were acquainted with medical properties of many herbs, which they used to cure certain diseases. The women generally presumed to know great many effective remedies, which they shared with their neighbors. People had considerable faith in Hakims, who had great influence with even opulent and educated people (Lawrence 1895). The knowledge of surgery was well nigh non-existent and barbers (jarahs) were traditionally doing the excision of boils, carbuncles etc.

Kashmir has had recurrent epidemics of cholera, small pox, measles, plague, typhoid, etc in medieval periods causing the death to, thousands of people at a time. The cause of these epidemics was the neglect and extreme poverty of people, due to loot and arson by invaders and the dirt and filth in which people lived. Surgeon Col. Harvey who visited Kashmir during the epidemics of cholera in 1892 writes, "it is not too much to see the inhabitants eat filth, drink filth, breath filth". Also one has to realize that the shape of the valley itself is like a bowl surrounded by high mountains and there were practically no roads, no proper drainage or sanitation in the valley. According to Lawrence (1895) one had to walk deep in the stinking slush when snow melted in spring to cross the roads. Due to cold climate, the incidence of infection is less, but once infection occurred, it took the shape of epidemics. Apart from these local factors, the attitude of the people was unhelpful. The Kashmiri people being very traditional, the hold which superstitious beliefs of all kinds had over the population was quite deep. The spread of any disease was normally ascribed to the will of God; so instead of obtaining any medical aid and recourse to any preventive measure, the people generally went to priests and holymen who gave them charms and amulets to be tied on arm or washed with water and taken orally. Hindus felt elated when smallpox came to their families, thinking Goddess 'Shetla', had visited their families and performed pujas as remedial measures. Till late into 20th Century, many Kashmiris were hesitant to get vaccinations done. (Biscoe, 1971)

MODERN TIMES

In the beginning of nineteenth century, Kashmir was ruled by Sikhs followed by Dogras from the year 1846. The western education and allopathic medical knowledge began to trickle in the valley after Christian missionaries came to Kashmir. People began to leave superstition and came to know about preventive medicine and opted for treatment by trained doctors rather than by holy men. Still for a long time, illiterate village folks did remain submerged in superstition. We have heard about many epidemics of cholera, plague, small pox, typhoid, influenza etc. in these times (Biscoe 1971) The western medical practice was brought to the valley in the year 1864 by *Dr. Elmslie*, but there being no hospital in the valley at that time, he worked in the open and operated under trees. After his death, came Dr. Theodore Maxwell in 1872, who got land for a hospital at Rustam Ghari at the foothills of Shankracharya hill. The famous Neve brothers, the British missionary doctors worked in this hospital and became a legend in their time. It was these two brothers *Dr. Arther* and *Dr. Ernest* F. Neve who brought modern surgery to the valley. In the year 1890 *Dr. E. Neve* also started the Leper hospital for the Govt. on the shores of Dal Lake and managed it for the state. By the year 1882-84, there was a Sadar hospital in Srinagar, dispensaries at Maharaj Ganj and Rainawari and branch dispensaries in all districts. Diamond jubilee Zenana hospital for women at *Nawakadal* was started by 1897, and Cottage hospital for European people at the foothills *of Shankracharya* hill by 1891.Church Missionary Society Zenana hospital for women at *Rainawari* was commissioned by 1908 and another one was built at Anantnag by the year 1909. By this time, there were other prominent European and Indian doctors working in Kashmir. *Dr. A. Mitra* from Bengal was the first Chief Medical officer of Sadar hospital in Srinagar. It was his untiring efforts, which helped in opening of the other hospitals in the state. Later on *Col. Dhuni Chand* was the CMO. A state of art x-ray plant was installed in Sadar hospital by the year

1913-14 and a dental wing was opened in January 1930.A sanitorium for T.B patients was started in Tangmarg by 1929.

The year 1940 was notable in the history of the Medical department of the State Govt. several important schemes to provide better health care facilities to the people of J&K State were introduced. These schemes included construction of two large hospitals one each in *Jammu & Srinagar* comparable with best medical institution elsewhere. The foundation stone laying ceremony of the Srinagar hospital (to be called *S.M.H.S* hospital) was laid by Marquis of Linlithgow, then Viceroy of India on October 15, 1940 and finally opened by another Viceroy Lord Wavell on 11th October 1945.

After independence of India, the medical practice in Kashmir is practically totally being manned by *Allopathic* doctors. The influence of modern education, increase in literacy and standard of living of people, and better communication contributed a lot towards it. In the year 1959, the first Govt Medical College was started in Karan Nagar Srinagar and with its opening, thousands of well-trained doctors have been produced who are managing the medical departments of the state. Not only are there MBBS doctors but each and every district has post graduate doctors manning the various specialities. Opening of another postgraduate institute in Soura called S.K.I.M.S in the year 1980, was an added feather to already very efficient, modern, upto date medical practice in Kashmir.

KASHMIRI MEDICAL SCHOLAR

Hakims

Pt. Sahaz Kak Bhat (1862 - 1935)

Born to *Pt. Zanardan Bhat,* a hakim by profession, *Pt. Sahaz Kak Bhat* (S.B) was last of the six children of his parents. He was 4 years old when he lost his father and was brought up by his elder brother *Pt. Sat Kak,* who held important position of royal physician to the Maharaja of J&K state. He had initial schooling at C.M.S School, Fatehkadal but soon left the English language and by self-education method learnt not only Persian, Sanskrit and Arabic, but also Unani medicine and eventually became a physician like his elder brother. His pronunciation of both Arabic and Sanskrit was so flawless that it was difficult to make out in which of these languages was he better acquainted. He also had a stint as a physician to His Highness the Maharaja of Kashmir. His clinical judgement was of far excellence and without having the blood pressure apparatus; he could by feeling the pulse, say about the status of patient's blood pressure. He described pulse of various diseases and could even diagnose pregnancy by the feel of pulse. He compiled his own materia medica and described various types of pulses, signs and symptoms of various diseases but unfortunately all his work was destroyed when the militants torched his house in 1990.

Pandit Sahaz Bhat was tall and handsome with a longish face and magnetic grace. His gait was majestic, his demur kingly, his disposition scholarly. By temperament he was magnanimous and benevolent and his generosity was proverbial. In conversation he was scholarly and inspiring. He had a musical voice and a handwriting that was calligraphic, so beautiful that his patients would often preserve his prescriptions in velvet bags to use them as amulets.

As for S.B. the scholar, it was his phenomenal knowledge of Persian, Sanskrit and Arabic that prompted the then Maharaja of J&K State to draft him into his Translation Department in 1890 as its head where he also looked after the publication of Sanskrit texts on philosophy, medicine, law etc.

With his mastery over Sanskrit, S.B.worked with *Sir Aurel Stein and Pandit Govind Kaul* in compiling a descriptive catalogue of 6000 Sanskrit manuscripts for Maharaja Ranbir Singh's Raghunath Temple library at Jammu. Considered in scholarship, the catalogue was printed in Bombay in 1894 S.B. painstakingly prepared extracts from each manuscript for the catalogue. Wrote Stein of S.B's labours: "For the most conscientious and scholarly manner in which *Sahaz Bhat* discharged it, I feel all the more obliged as I can well realize how irksome a great portion of the work e.g. the careful reproduction of innumerable classical errors and apashabdas of the manuscripts must have been to his Pandit instinct. His learning and thorough acquaintance with the methods of Indian scholarship especially in the shastras traditionally cultivated in Kashmir have on many occasions most usefully supplemented my printed source of references.

Another work in which S.B. collaborated with Stein and *Govind Kaul* was Hindi translation of the Sanskrit chronicles of Kashmir, but it could not be completed due to *Govind Kaul's* sudden death in 1899.

In 1935, S.B. passed away after fulfilling life of a scholar and physician always sought after by fame. *Aurel Stein's* regard for his scholarship can be summed up in the following excerpt from a nostalgic letter he wrote to Alden, one of his friends in Vienna in 1905:

"I gathered my old entourage. It was pleasure to talk the language of Gods and though my interests have now moved far northward, I shall try to keep my old friend *Pandit Sahaz Bhat* by me when I occupy winter quarters at Gupkar where he had been with me and Govind Kaul in the old days".

(Unmesh, 1998 & Dr. K.L.Bhat)

Pandit Sham Lal Bhat ***(1900 - 1984): -***

Another famous Hakim of Kashmir was son of his illustrious father *Pt. Sahaz Kak Bhat.* He graduated from Sri Pratap Singh College, Srinagar. He was known far and wide for the treatment of various ailments especially for renal stones. He was practicing till his demise in his ancestral house at Habbakadal Srinagar. His two sons *Dr. R.N.Bhat* MRCP; and *Dr. K.L.Bhat* FRCS; are very well known medical consultants. *Pt. Sham Lal Bhat's* brother *Dr. Narayan Nath Bhat* LMP was also a medical practitioner of Kashmir, who rendered great service to Kashmiri community during the famous cholera epidemic of 1935.

Other Hakims

Some of the well known Hakims of 1920's are *Pt. Lassa Kak Hakim, Pt. Anand Kaul Hakim, and Pt.Balji Hakim.* They were working in Rainawari area of Srinagar. They had patients from all over the valley.

According to Lawrence (1895), there were 300 Hakim in Kashmir in the year 1891 - 1892. The commonest diseases were the epidemics of Cholera, small pox, blindness, leprosy and insanity.

There was no suicide case in Kashmir. The basic remedy of the hakims was the herb called Chob -I-chin (similax china). People did go to peers and fakirs for the cure of diseases and only went to European doctors only for surgical complaints or when in extreme stage.

Allopathic Doctors

Dr. Deva Kaul was a legend in Medical profession in Kashmir. He qualified from King Edward Medical College, Lahore in the year 1918 and remained in Govt. Services till 1929, when he resigned and set up his own private practice. Inspite of almost non-existent investigative facilities in those days, his clinical sense of diagnosing diseases was incredible. He not only worked as a physician but also a guiding force for all his patients. He passed away in the year 1944, at a young age of 45 years.

Dr. Sudharshan Kaul (Mahaldar) did his MBBS from Lahore in 1918. He joined the Govt. service and treated patients of far and wide. He retired as epidemiologist in early fifties.

Dr. Shivji Dhar was the first trained radiologist of J&K State, who managed the x-ray department at Sadar Hospital, Srinagar. In late 1930's he started a private x-ray clinic called Shivji's x-ray clinic at Amira Kadal, Srinagar. The clinic did yeoman's service to the people of Kashmir. The quality of films taken at that clinic can match the best taken anywhere in the country. Presently this clinic is run by *Dr. Hiralal Dhar,* a grandson of *Dr. Shivji.*

Dr. Govind Lal Vaishnavi MBBS, DOMS (London), D.L.O R.C.P &S England, FRCS (Edin) F.R.F.P.S (Glas), F.R.S.T.M & H (England).

Dr. Vaishnavi, the first British trained FRCS of J&K State passed MBBS in 1925 from Lahore. He joined the State Govt. as medical officer Sadar Hospital, Srinagar in 1925 and 2 years later proceeded to U.K for higher studies. After return from U.K he worked in various capacities as E.N.T specialist, palace surgeon, CMO J&K (1935), Director Medical Services (DMS) J&K state (1943) before retiring from State Service in 1948. During his tenure as CMO and DMS, the health care services in the entire State registered a phenomenal improvement. Dispensaries and Health Centers were established all over to enable people easy access to get medical services. Epidemiologists for Jammu & Kashmir pro\inces were placed in position to successfully prevent epidemics, through mass inoculation and vaccination. Infectious diseases hospital at Srinagar, two preventable diseases Bureau, one each at Jammu and Sringar were established Srinagar Lunatic Asylum was converted into a Mental Hospital during this period.

It was his vision and planning that led to establishment of a 320 bed Hospital equipped with State of art facilities and infrastructure with all major departments manned by specialists. This hospital, the construction, equipping and commissioning of the facilities of which was personally directed by him was named SMHS Hospital and formally opened by then Viceroy of India Lord Waveli on 11th October 1945.

After his retirement from J&K Services he was appointed as Assistant Director General Medical Services Govt. of India for 2 years and later as Chief Medical Officer, Calcutta Port Commissioners for 5 years. (1952 to 1957).

This doyen of Medical profession was a saintly man, humane, full of compassion and healing touch. People in general and medical professionals in particular are indebted to him for standardizing the medical practice on western standards and the values which he inculcated with dedication in medical fraternity is still being propagated by successive generations of medicoes of Kashmir. Last years of his life, he spent in solitude and meditation passing away in 1976.

Dr. Gwash Lal Kaul M.R.C.P (London), MRCS (London), was a contemporary of *Dr. G. L. Vaishnavi.* He was also the first M.R.C.P of J&K State. Where as Dr. G.L.Vaishnavi had looked after the surgical practice of the valley, *Dr. Kaul* was the chief physician of his times. As there were many epidemics of various diseases in the valley in their times, *Dr. Kaul* was the main anchor to organise the preventive as well as curative health care in his time. People in Kashmir still remember him fondly and narrate many incidents and stories pertaining to his often unorthodox but successful treatment of serious diseases.

Dr.S.N.Peshin F.R.C.S: - was a well-known surgeon of Kasiimir. He along with *Sh.Sheikh Mohd Abdullah, Dr. Gopinath Chogtu and Dr. Ali Mohd Chiken* started a charitable hospital by the name of National Hospital, Karan Nagar, Srinagar in the year 1937 with people's donations. Later Dr. Peshin was appointed CMO and Director Health Services of Kashmir by Late *Sh. Sheikh Mohd Abdullah.*

Personal Communicational by Dr. S. N. Ahmed Shah

Dr.(Col) Saligram Kaul MD FRCP(London),Col.Kaul did MBBS in 1937 from Lahore, MD Medicine with cardiology as special subject in 1953, MRCP (London) in the year 1951, (passed the exam in 9 months only), and later was admitted to FRCP (London). He was the youngest of about 20 Indian fellows of the Royal College of Physician of London elected till 1967. He was a brilliant student, stood first in most of the subjects, had distinction in pathology and Forensic medicine and had earned many medals, merit scholarships from Govt of Kashmir and Universities. After his graduation he joined Army Medical Corps where he spent 21 years of service in the capacity of medical specialist, advisor in Medicine to Southern command, post graduate teacher in Medicine and professor in AFMC Pune. He came back to state of J&K as professor and HOD Medicine in Govt. Medical College Srinagar in early sixties and became principal of the college, for 3 years, Dean Faculty of Medicine J&K University for 3 years, Director Health Services and Family Planning J&K state and Secretary to Govt. Advisor incharge Medical Education Deptt. J&K Govt.

Prof. S. Koul, inspite of his so many administrative postings is essentially a brilliant teacher, a researcher. He is a clinician par excellence who has authored a textbook on Practice of Medicine for undergraduate and post graduate courses, contributed chapters in different text books of medicine and published 31 papers in basic research, specially in the use of Radioactive Isotopes in clinical medicine in India. He has been the first in medical literature to record and publish the, (i) Syndrome of Neurological and Hapatic involvement in influenza, (ii) Vestibular Neurovities, (iii) Glycogen storage disease in Asia and (iv) Psittacosis in India. His work is quoted by foreign authors in the textbooks of medicine. He is widely known and respected in medical fraternity in India and even in his advanced age, has sharp intellect, diagnosis and understanding of the subject of medicine like a young brilliant medical student. I have had the good fortune to be a student of this great teacher.

Dr. G. L. Koul FRCS:- Son of Shri. Gana Lal Koul studied in Shri S. P. College, Srinagar. He was the younger brother of Dr. Gwash Lal Koul. He did his MBBS from Lahore in the year 1930-31 and FRCS from Edinburgh in 1958-59. He was one of the pillars of surgical practice in valley and worked tirelessly for the poor and needy irrespective of their caste and creed. He was instrumental in shaping the surgical department of Govt. Medical College, Srinagar where he was a Professor, along with other surgeon colleagues. Prof.Koul retired in 1966. He was a keen golfer after retirement and expired in the year 1987.

Prof. Dr.B.M. Bhan FRCS:- He is a senior professor and was HOD of surgery, Govt. Medical College Srinagar. He had joined the college at its inception in the year 1959. He is very honest, up to date, strict disciplinarian and a brilliant clinician and a surgeon. He is highly respected teacher and a humanitarian who is still in Srinagar looking after the Kashmir community at the cost of personal risk to his life due to militancy in Kashmir.

Dr.Capt. M.N. Bhan IMS MBBS, D-path was one of the earliest trained pathologists of Kashmir. He passed his MBBS from Lahore and D-path from Calcutta. After MBBS he had joined state service from where he joined IMS and saw active service in Burma with Gen. Slim's forces. After end of 2nd world war he came back to state and was the clinical pathologist in S.M.H.S Hospital, Srinagar till his death in 1966.

Dr. J.N. Kachroo MBBS, DA is the first trained aneathetist of the valley. He passed his MBBS in 1936 from Lahore and DA from Bombay. He joined the state service and was working as senior consultant aneathetist in S.M.H.S hospital and Govt. Medical College Srinagar. After his retirement he was doing private practice in the city of Srinagar. These days after his exodus from valley in the year 1990, he is working as anesthetist in Rama Krishna Mission Hospital, Haridwar.

Dr. A.N. Parimoo* and *Dr. Sham Lal Kaul were other two locally trained anaethetists of the valley who have served people in those trying circumstances when the speciality of anaethesia was in infancy all over the world. In Govt. Medical College Srinagar, *Prof. C. L. Dhar, Prof. Phoola Kaul* and *Prof. Chunni Magazine* were other well-known anaethetists who are still working in private after their retirement. *Dr. N. N. Ganju was a contemporary of Dr. G. L. Kaul but died young thus ending a brilliant career.*

Dr. M. L. Kaul MBBS, DMRD, he is one of the very well known radiologist of the valley. He passed his MBBS in the year 1940, and worked in various dispensaries in the valley and finally was the radiologist in SMHS hospital Srinagar, from where he retired. He is a brilliant radiologist very well respected for his diagnostic acumen. His x-ray clinic in Karan Nagar, Sringar has been a very busy private clinic for decades. He is leading a retired life in Delhi after 1991.

Along with men, the Kashmiri Pandit Ladies too started going for medical studies in late 40s. One of the first trained lady doctors is probably *Dr. Prabha Labroo* LMP followed by *Dr. Sheela Razdan* MBBS 1948, *Dr. Shanta Wazir Bhargava* 1949, *Prof. Dr. Gauri Bazaz Malik* MBBS.MD 1950, *Dr. Prabha Ganju* MBBS 1952, *Durga Kaul Ganju* MBBS 1954 and *Dr. Shanta Raina.* Most of the above mentioned doctors were manning the obstetrical part of the women folk and some of them did perform minor gynae surgery as well. Inspite of less number of women doctors these pioneers have really looked after the women of Kashmir till better trained gynaecologist and obstetricians took over after the start of Govt. Medical College, Srinagar.

Dr. Bhargava* and *Dr. Malik are both pathologists who worked in Delhi only.

Prof. Dr. Girja Dhar MBBS, DRCOG, FRCS:- *Prof. Dhar* has been one of the pioneers in the gynaecology speciality who has been a British trained doctor. She did her MBBS in the year 1956 from K.G.M.C Lucknow, followed by DRCOG London 1962, FRCS (Edin) 1964. She joined the department of obstetrics and gynaecology in the Govt. Medical College Srinagar in the year 1964 as Assistant Professor and then was HOD of the department till the year 1985. She was selected Dean and Principal of Govt. Medical College Srinagar till her retirement in 1992. After her retirement from the Medical College, *Dr. Girja Dhar* was member. State Public Service Commission (PSC) for three years, chairperson social welfare advisory Board for one year and since March 2000 is working as chairperson state commission for women.

One of the very polished and poised women, *Dr. Dhar* has been instrumental in running the Gynae and obstetrics services in the valley. She is an excellent teacher and clinician and by training postgraduate doctors in the speciality has provided excellent care to the women folk of valley. The main diseases like high BP of pregnancy, Eclampsia, Antipartum Hemorrhage, abortion, anemia, rupture uterus etc. which were the main causes of maternal mortality in the valley have been greatly reduced by these young gynaecologists of the valley.

Prof.Dhar has been assisted by the team of other professors in the department like *Prof. Leela Choudhary, Prof. Sheela Kachroo* and *Prof. Shakti Bhan.*

One cannot overlook the efforts of many general physicians who worked tirelessly and looked after the health of people. Most of them did join the State Govt. services for some time and later devoted whole time in private practice. *Dr. P. N. Kaul* MBBS, DTCD (chest physician) *Dr. S. N. Ganjoo, Dr. G. N. Wali, Dr. G. N. Choglu, Dr. Samar Chand Bhat, Dr. J. L. Kaul, Dr. S. N. Gassi and Dr. S. K. Shangloo* were some such prominent physicians of Kashmir in the 2nd half of last century.

After the start of Govt. Medical College Srinagar, there were many medical specialists and super specialists in Kashmir. It is beyond the scope of this paper to write individually about all of them. However, *Prof. S. N. Dhar, Prof. K.L. Choudhury, Prof. S. N. Kaul, Dr. D. N. Thusoo* - all physicians; *Prof. Puran Raina,* Pediatrician; *Dr. B. K Jalali* and *Dr. D. P. Bhat* - Surgeons; *Dr. P. K. Hak,* E.N.T specialist and many others have been associated with the Govt. medical college Srinagar. There are many of our super specialist who have not worked in Kashmir but have excelled in their work elsewhere, either in rest of India like *Prof. U. Kaul,* Cardiologist; *Prof. J. P. Wali,* Physician; *Prof. T. K. Thusoo,* Surgeon; *Dr. Anil Bhan*, Cardiothoracic surgeon; *Prof. Vijay Kher*, Nephrologist etc. and *Dr. P. K. Shah*, Cardiologist; *Dr. Nirmal Mattoo*, Nephrologist; *Dr. G. L. Hanjura*, medical Oncologist; *Dr. G. L. Bhan*, Physician; and *Dr. Asheesh Vaishnavi* gatroenterologist in U.S.A. and U.K.

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I am sure I must have failed to mention many medical scholars. It is just the first attempt in this direction. The inadvertent omissions may be overlooked.

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CHAPTER 11

DEVELOPMENTS IN SCIENCE OF ARCHAEOLOGY IN KASHMIR

T. N. Khazanchi

Archaeology denotes the science of ancient remains. It has long been accepted as a scientific discipline providing tangible evidence for building the superstructure of history. In fact its claim is accepted as supreme especially in such periods where written records are absent or have remained undeciphered. Where, however. written records exist, the material remains turned up by the spade convey in a telling manner the import of the written record.

Kashmiris like a jewel in the womb of Himalayas. Nature has been bountiful in the form of shimmering lakes, snow capped majestic heights lush green meadows, pageantry of colour, exhilarating dawns and sunsets, gurgling springs and rivulets, which have considerably affected the lives of the people, not least in the field of art. Due to the receptiveness of the people, the artistic instincts were stimulated by the exquisite natural splendour in which their lives were steeped. Kashmir lay on the route to High Asia, and inspite of the ebb and flow of great external movements on its borders or tribal intrusions from the North or the forays of some of the local rulers into distant territories, Kashmir consistently managed to maintain a certain indigenous and independent type of culture, as reflected in the field of art, architecture and crafts which indicates the inherent aesthetic sense and rare adaptability of its inhabitants. The ancient remains and monuments in the valley clearly indicate the heights achieved.

But how did it all begin. That by itself is an exciting story. I have had the proud privilege of stepping on the footprints of our earliest ancestors who settled on the soil of Kashmir after the vast lakes had drained out and the soil was fit for habitation.

That Kashmir was once a. vast lake, known as "Satisaras", the lake of Parvati, is enshrined in our traditions. There exists a general consensus that the rise of pirpanjal range was responsible for impounding the primeval drainage and giving rise to a vast Karewa Lake. As the Pir Panjal continued to rise, the Karewa lake shrank and shifted to the Himalayan flank. At some stage, the Jhelum emerged from a fault near Baramulla and drained out the lake.

"There is a close uniformity in physical features and geological continuation of the sub Himalayan tract from Rawalpindi to Dehradun covered by the Siwalik and Sirmur rock systems. The Central Himalayan axis, after the bifurcation near Kulu runs as one the twin peaks of Nunkun (23444'); the other branch runs due west as the high range of Pir Panjal. Between these two branches of the axis lies a longitudinal valley with a south-east to north west trend, some 135 kms long and 40 kms broad in its middle. The total area of Kashmir valley is 3040 sq.km."

Pleistocene or Post Pliocene deposits of the nature of fluviatile, lacustrine or glacial, have spread over many parts of Kashmir and occupy a wide extent. Of these the most interesting as well as conspicuous examples are the fresh water (fluviatile or lacustrine) deposits, found as low flat mounds, bordering the slopes of the mountains above the modern aluvium of the Jhelum. These are known as Karewas or *Uddars* in Kashmir. The Karewa formation occupies nearly half the area of the valley. It had a width from 12.5 to 25 km alongwith its south-west side and extends for a length of nearly 80 kms from shoppayan to Baramulla. The Karewas are mostly horizontally stratified deposits consisting of fine-grained sand, loam, blue sandy clays with lenticular bands of gravelly conglomerate. At some localities the finer sands and clays show laminations indicating periods of summer melting of ice and of winter freezing.

Evidence of oscillations of the glacial cloimate is recorded in the Karewa deposits. At the end of the ice - age there was a forest period in the Kashmir Valley. Karewa has been traced continuously upto almost the summit of the Pir Panjal.

The Neolithic settlers occupied the commanding terraces of the Karewas. At Haigam, the pollen profile shows clearance of pine forest which may have something to do with agricultural activity.

Geologically the Karewas provided a commanding set up and as such attracted the attention of the earliest settlers. The forests were in the vicinity and provided adequate grounds for the hunt, the stream beds girdling various areas provided the material for fashioning the stone tools. The marshy areas and lakes provided enough scope for fishing and fowling.

Early in the post-glacial times, an important change was taking place in human evolution; man began to control his environment and was thus enabled to settle down in villages effectively. The food gathering or hunting economy of the Mesolithic forbears of the late pleistocene times gives way to deliberate food production involving husbandry and stock raising. This change in human economy constituted what has been termed as "Neolethic Revolution", and took place in different areas over a great range of time. It represents a stage in economic and technological development. Other traits often associated with this new way of life are the grinding and polishing of tools and the manufacture of pottery. The manufacture of pottery in some excavations proved no longer an essential attribute of this culture. The use of metal was unknown in the typical neolithic economy.

The trail was blazed by M/s. H. De-Terra and T.T. Paterson of the Yale and Cambridge University Expedition who were in pursuit of Early Man in the valley. They studied the history of glaciation in Kashmir. Man had aleady appeared in the valley in the second Interglacial period. What is, however, of interest to our topic is the fact that they discovered the Megalithic site of Burzahom during their exploration. This proved to be a landmark since subsequent extensive excavations added a new chapter to the history of Kashmir. M/s. De-Terra and Paterson excavated the area near the Megalithic complex for about a week or so, resulting in finding a few polished stone and bond tools. This attracted international attention. As soon as the State Deptt. of Archaeology was integrated with the Archaeological Survey of India in 1960, I was asked to undertake the excavation in depth and detail. The site was excavated vertically and horizontally from 1960 to 1971. In a vertical dig the cultural sequence is established, and in case it is intended to determine the details of the various phases, the dig is taken up horizontally. To detail out the results achieved in full is outside the scope of the Present Paper, but it is intended to emphasize the scientific aspects in relation to the Developments in Archaeology in Kashmir.

First and foremost the excavation conducted at Burzahom was the first of its kind in Jammu & Kashmir on the basis of stratified cultural deposits. It was the first habitation site of its kind in Kashmir which was extensively excavated. The concept of stratification in archaeological excavations on the geological model was first introduced in India by Sir Mortimer Wheeler, the then Director General of the Archaeological Survey of India, when he conducted excavations at Bhir Mound in Taxilain 1944. He was in pursuit of identifying the Aryans on an archaeological basis. He trained a number of students from various parts of India, and I happened to be one of them for three years. The second excavation on this model was conducted by Dr. Banerjee and Dr. A.K. Sharma of the Prehistory Branch of the Archaeological Survey at Gufkral in Tral area in early eightys. The site at Guf Krai is a similar one as at Burzahom. The last habitation site was excavated at Semthan in Bijbehara by Sh. R.S.Bisht who is now a Director in the Survey.

The extensive excavations at Burzahom indicate in detail the "neolithic revolution" that took place in the valley after it was fit for habitation. This culture as represented at Burzahom and a few other sites in the Jhelum Valley of Kashmir shows some unique characteristics which single it out from the other Neolithic cultures of India. In the earlier phase, the inhabitants lived in circular or oval pits, dug into the Karewa soil. Evidence of landing steps and niches in the sides of the pit and deposits of ash etc. on the pit floors confirms their use for dwelling purposes. The traces of Post holes along the edges of the pits suggests the use of timber superstructures. Their way of life seems to be primitive. Besides polished stone implements, such as axes, adzes, pounders, chisels etc. they made effective bone tools, including awls, needles, points, chisels, hapoons. Their pottery was largely hand made and showed mat impressions on the base.

In the succeeding phase, pit dwellings were abandoned and structures of mud and mud bricks were built on ground level with plastered floors, often coated with red ochre. A new ceramic with black burnished surface made its appearance. Another innovation in the craft was the introduction of the potters wheel. Polished stone axes and bone tools came to be used in large number. Knowledge of metallurgy was acquired towards the close of this phase, the evidence being confined to a few copper arrow heads.

Burials, of which evidence was from phase II and the Megalithic level, showed both primary and secondary interments - the former containing extended articulated skeletons and the latter only partial, viz sleeted bones. In the graves, domesticated animals like dog and goat or their bones were often deposited alongwith human skeletal remains. Instances of trepanning the skull, suggestive of their magico religious beliefs are also found. Animal burials also showed both articulated and fractional (incomplete) skeletons, the animals being dog, wolf and ibex. One of the burials contained skeletal remains, belonging to five wild dogs and antlers horn. The burials both human and animal were found within the habitation area itself.

Neolithic settlements in Kashmir are quite densely distributed. In the Jhelum Valley alone, from Anantnag to Pampur, a number of sites were discovered e.g. Begagund, Gufkral, hariparigom, Jayadeviudar, Olchibag, Pampur, Panzgom, Somburand Thajivor. Other sites in the valley are Gurhoma Sangri near the Wular lake and Damodar Karewa, south west of Srinagar. The sites at Aripanthan, near Magam, at Puthkah near Sangrama, Duviekampura on way to Gulmarg are noteworthy. Gandarbal in the Sind Valley and some pockets near Wangath Nallah were explored by Paterson. This clearly shows that the valley was pulsating with the Neolithic people and their descendants as time advanced. Not all the Neolithic sites were capped by a megalithic complex, but some of these were.

The story of man in Kashmir is a fascinating one, more so if you happen to be the son of the soil. Having spent nearly eleven years of my active life at the site. I felt I was breathing down, the neck of the Burzahomians, and hearing the echoes of their struggle for survival against a hostile environment. This story would have not been fully meaningful or comprehensible but for the cooperation provided by the various Research and Scientific Institutes in the Sub continent. The Radio Carbon dates were determined by the Tata Institute of Fundamental Research and the Birbal Sahwney Institute of PaleobotanyatLucknow. The wood samples were identified by the Forest Research Institute at Dehradun. The burials, both human and animal were worked out in detail by the Anthropological Survey of India. Without these scientific aids the story would have been a hazy one.

Neolithic period was followed by Megalithic period. This period is indicated by the erection of menhirs which are huge standing stones. A new wave of people arrived in the valley and started living with the neolithic setlers.

There is no evidence of any physical or cultural conflict between the new and the old. With the Megalithic phase wheel made dull red ware, rice, iron, and copper are in evidence. It appears that the menhirs were only commenmorative rather than funerary in character, as is the case in the Southern Megalithic complexes. The structures of this period were generally built of mud and rubble. In this period stone axes, adzes, and harvesters are available in less percentage, as compared to the Neolithic period. Bone tools continued to persist. The most interesting bone tools were cobbler's poker and bone handles. Carnelian, agate and wooden beads and bangle were the ornaments of the period. The most important feature was the introduction of iron in the valley around 1800 B.C. Weaving of finer clothes has started.

Megalithic period was followed by the early historical period. A good number of radio carbon dates from Burzahom and Guf Kral has given an unbroken sequence of cultural developments in the valley. Neolithic people came to the valley around 2800 B.C., hand made pottery was introduced round about 2400 B.C. and iron was introduced in about 1800 B.C. Rice also came to the valley alongwith the Megalithic people. At no stage was there any cultural conflict.

In discussing the origins and affinities of the Northern Neolithic culture certain things at once strike the eye as foreign to the Indian tradition. Among them are the form of the bone tools, the rectangular stone perforated knife or the harvester, the Pit dwellings, and the placing of domestic dogs in the grave with their masters. Each one of these features is found in the Neolithic cultures of north China. The perforated knife or the harvester, in particular being a characteristic trait, and a dog burial in the Neolithic culture of Manchuria. The dog was apparently a cult animal in the Shilka Cave culture of the upper Amur; and dogs were until recently sacrificed and buried with their masters among such peoples as the Gilyaks, Ulchis and Goldis of this region. A bone industry including harpoons, is also a frequent occurence of north Chinese Neolithic sites.

On the other hand, the Burzahom ceramic industry is not obviously comparable with any Chinese neolithic pottery. In short, Burzahom Neolithic appears as a hunting based culture whose affinities are with the Neolithic and surviving hunting people of the peripheral regions north and northwest of China and of Central Asia. The question of relations with the other Indian Neolithic groups cannot be established.

While racial contacts could be traced to Central Asia the evidence of contact with Southern Plains which was geographically closer to Kashmir and where chronologically pre-Harappan Pot from Burzahom and Carnelian beads, both from Burzahom and Gufkral is clearly established. It is now evident that the early Harappans had contacts with the neolithic people of Kashmir and the northernmost limit of the Harappan culture is at Manda in Jammu Presence of Boxwood (Buxus Wellichiana) at Gufkral (which is not reported in Kashmir valley), but is found in Poonchand Udhampur, south of Pir Panjal as also in Muree, Baluchistan which clearly shows that the people of the valley had close contacts with the people of these regions from where they imported this wood. As Box wood is mainly used for engraving and carving work, its presence at Gufkral in neolithic levels, shows that the delicate work of engraving and carving was known to them as early as 4500 years back.

Inspite of the Scientific inputs by the various Research Institutes, the Anthropological Survey and the Geological Survey, there are wide gaps in the story of Early Men in Kashmir. The Neolithic Revolution that took place in the valley during the 3rd Millenium B.C. seems to be a sudden outburst. There are no clear indications regarding the transition from the Paleolithic, through the

Mesolithic forbears to the neolithic revolution that took place. We are not in a position to say firmly that the Neolithic Culture evolved in the valley. Inspite of contacts with China, Central Asia, West Asia and other Northern Areas, immigration is not clearly established. These problems could have been solved with extensive field work and excavations in the valley as also explorations in the Northern Areas. We hope and pray that it may be possible for us to do so in the near future.

CONCLUSION

Archeology has long been accepted as a scientific discipline providing tangible evidence for building the superstructure of history. Its claim is accepted as supreme for such period where written records are absent.

Kashmir consistently managed to maintain a certain indigenous and independent type of culture, as reflected in the field of art, architecture and crafts. The ancient remains and monuments in the valley clearly indicate the heights achieved.

How it all began is an exciting story. Kashmir was once a vast lake, known as "Satisaras". The rise of Pir Panjal range was responsible for impounding the primeval drainage giving rise to a karewa lake. Later the Jhelum emerged from a fault near Baramulla and drained out the lake.

The karewas or Uddars which dominate the landscape in the valley emerged in the process. The earliest Kashmiris settled on these forests were in the vicinity and provided the hunt. The marshy areas and lakes provided enough scope for fishing and fowling.

Early in the Post-glacial times, the "Neolithic Revolution" took place. It represents a stage in economic and technological development.

The megalithic site of Burzahom was discovered by M/s H. De-Terra and Paterson in 1936. They were in pursuit of Early Man in Kashmir. In view of its importance it was excavated in depth and detail under my supervision in 1960 and continued upto 1971. The results have proved to be very fruitful. Another similar site at Gufkral in Tral area was excavated by Dr. Bannerjee and Dr. Sharma of the Archeological Survey of India.

The finds have been prolific in the form of distinctive bone and stone tools. Burials both human and animal, primary and secondary, have been found. Some of the features indicate active contact with north and north-western China. Some burial practices indicated close contact with Central Asia and surrounding areas. Commercial contacts with Pre-Harappans is also indicated. Scientific in puts by the various Research Institutes in the Sub-Continent have proved effective in assessments. However, there are no clear indications regarding the transition from the paleolithic through the mesolithic forbears to the neolithic revolution that took place. Extensive field work and research is still needed to fill in the gaps.

CHAPTER 12

BODY'S FIGHT AGAINST CANCER

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INTRODUCTION OF AUTHOR

My ancestors were called Tikoos, nobody knows about the grotesque transgression of Tikoos to Khars. Basically the residents of Vicharnag, my grandfather Pt. Aftaabjoo Khar chose to live nearer to the city in Mallapora / Bana Mohalla. My father Pt. Badrinath Khar retired as Deputy Secretary to the J&K Govt. and moved to Jawahar Nagar in 1962.

I had my Bachelors from J&K University (1967), Masters in Biochemistry from Calcutta University and Ph.D. in Biochemistry from Panjab University (1975). After doing my 5 years post-doctoral in endocrinology from CNRS, Paris, I joined the Centre for Cellular & Molecular Biology at Hyderabad in 1980. At present I am holding the position of Director-Grade Scientist. My major scientific interests are Biochemistry, Tumor Immunology, Molecular & Cell Biology and tissue culture.

Twentieth century can be called the crowning era of the scientific achievements of man. The nature's tightly shut book was opened leaf by leaf and the baffling nuances solved by the super intelligence of the super creation. But what still remains a mind boggling, frustrating and even dismaying puzzle for the scientist is the most dreaded and disdained disease; the cancer.

Cancer being a highly complex disease with varied origins, has been difficult for the researchers to conquer. Inspite of about four decades of scientific inputs and heavy investments, though faced with much failure, still there is lot of interest in the scientific community regarding this disease with the hope to achieve significant insights/breakthroughs one day.

We have been lucky in developing an animal tumor model way back in 1986 that regressed/rejected spontaneously (without any external intervention) in syngeneic hosts. The tumor that we have been working with grows into a histiocytoma and is called as AK-5. AK-5 tumor cells when transplanted subcutaneously in rats, grow as solid tumors but get rejected in about 70% of the hosts (Figure 1), whereas when the tumor cells are transplanted in the peritoneum, this tumor grows as ascites and kills 100% animals.

During the last 16 years we have studied the interactions between the host immune cells and the tumor cells. How exactly our body's defense mechanisms (immune system), receive the signal, what type of immune cells respond to these signals and get activated to produce small molecules called interleukins/cytokines. The interleukins produced are involved in the activation of other immune cells.

The immune system is comprised of T-lymphocytes, B-lymphocytes, Natural killer cells, macrophages, Dendritic cells etc. Our studies have shown that all the immune cells participate in the process of killing the tumor cell in the host, however, the Natural killer cell is the main effector cell. We have also shown that Natural killer cell requires to be primed/activated before it can participate in the killing of the tumor cell. The activation of Natural killer cell is achieved by interleukin-12 which is produced by the host macrophages.

We have also studied the actual mechanism of killing of the tumor cell. Our studies have shown that tumor cell killing by natural killer cells is mediated through necrosis as well as apoptosis. Necrosis is mediated through the production of perform that makes holes on the tumor cell surface, whereas apoptosis is mediated through the production of an enzyme called Granzyme that is involved in the activation of several genes involved in the apoptotic cell death processes.

In our studies we have shown an efficient mechanism of tumor cell death leading to spontaneous regression of the tumor. Our studies pin point that a concerted effort by different types of immune cells is required to achieve complete tumor regression.

Although these studies are performed using animal models, we hope that they will have some applications/impact on human tumor systems. However, the take home message being that the host immune system has to be fully geared to fight a cancer cell, only then the total eradication of the disease could be achieved.

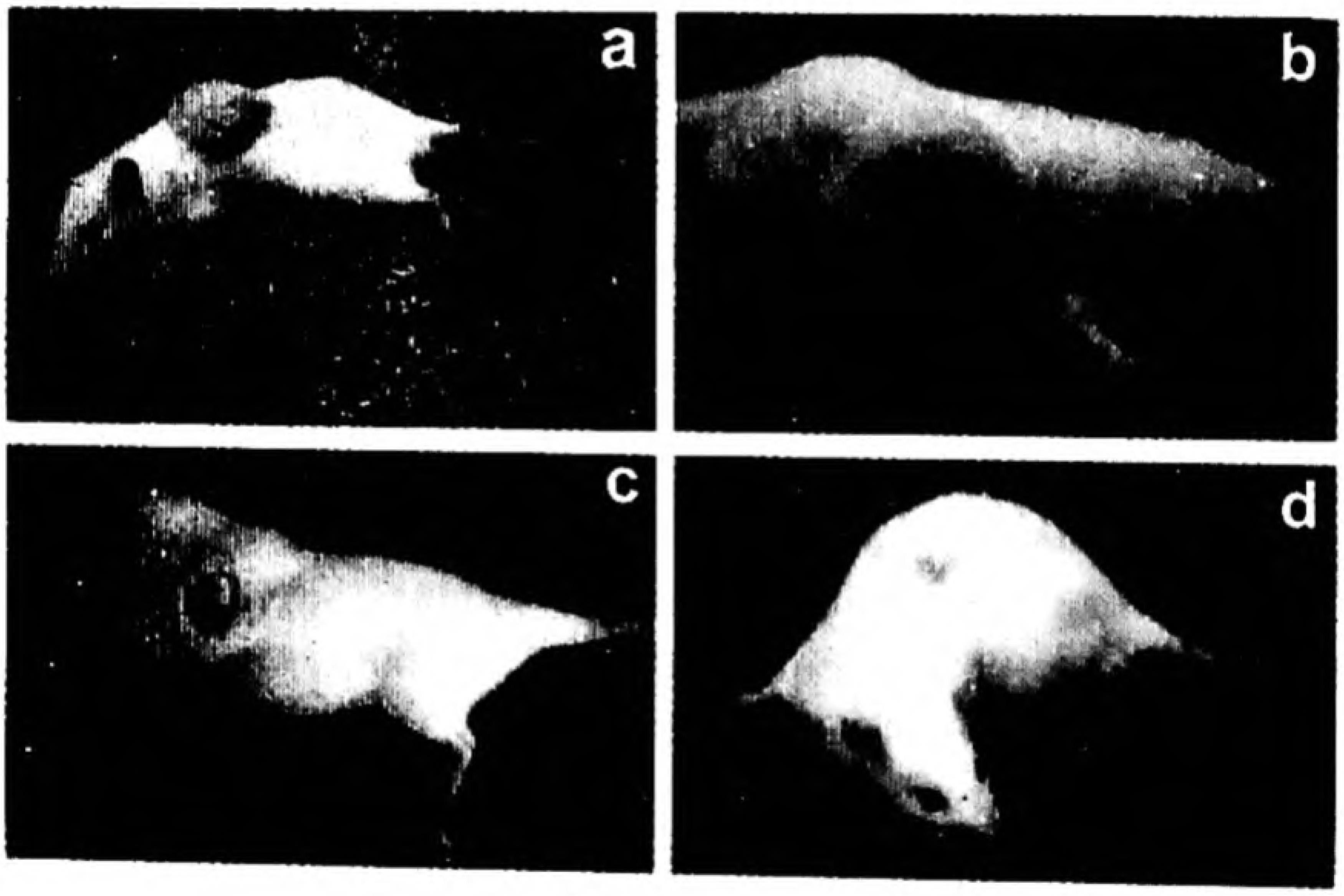

Figure 1

AK-5 tumor growth and rejection in rats, (a) 10 days old tumor; (b) 18 days old tumor; (c) 30 days old tumor showing necrosis/wound and rejection; (d) 35 days old tumor totally rejected with healed wound.

SCIENCE AND SPIRITUALITY

M. K. Kaw

President KECSS

INTRODUCTION

There is a very conventional distinction drawn between science and spirituality. It is said that science deals with the universe outside us, and spirituality with the universe inside us.

I have always contested this sharp compartmentalization of reality into inner and outer segments. Reality is one and indivisible. We live in a seamless web. There is no distinction between the sacred and the secular, between God and the universe, between consciousness and matter. The divine permeates everything and hence everything is sacred. God is the soul of the universe and the universe is the body of God. Matter is nothing but a gross manifestation of consciousness. All this division of Indivisibility into fragments is the achievement of our analytical mind, which knows nothing except the technique of dividing reality and naming the different parts. Thus it creates the illusion that it is studying reality and arriving gradually at the heart of it. The truth is that division of reality only leads to our looking at a small piece of it and trying to visualize the whole from the part. This is a misadventure doomed to failure from the very start.

Paper presented by M.K.Kaw at the Seminar on Science and Synthesis organized by the Kashmir Education, Culture and Science Society on 7th April 2002 at Pamposh Enclave, New Delhi

What we do have is the science of spirituality. Spirituality is the study of the total and the indivisible, the beginningless and the endless reality, the unborn and the undying truth. Let me clarify that I am not here talking about religion.

SPIRITUALITY AND RELIGION

The confusion, which equates spirituality to religion, is responsible for a lot of woolly thinking in the world. Religions are historical points of reference. They occur in history, because of the ascendancy of one or more individuals, who wield some kind of charismatic influence over a large population. The historical religions have followed similar paths and if you study these, you find certain factors to be common to most of them.

A typical religion would have the following ingredients. First, it has a science of spirituality as its core. Secondly, a bigger portion deals with the technology of spirituality. Thirdly, it has other elements like commerce, politics, etc.

It is my hypothesis that the science of spirituality is a single science. Just as there is no Indian Chemistry, Arab Chemistry and British Chemistry, similarly there cannot be a Hindu, Muslim or Christian spirituality. If there are differences of expression, it is because the same truth is couched in different kinds of poetic language that is notoriously vague and ambiguous. If there are differences of perception, it is because the same truth is experienced at different levels of awareness.

The technology is, of course, a different matter altogether. Technology operationalizes the scientific theory. Each person may apply a theory to his own life and his own situations as they arise from time to time. There is bound to be tremendous experimentation with different options, because the world-view of each person is different.

And as for the commerce and the politics, religion has always given shelter to those who are unfit for all the professions but can make a reasonable living off God. There are politicians galore who jump at every opportunity of sowing divisions among the adherents of different faiths, in order to rule over them all.

IS SPIRITUALITY A SCIENCE?

How is spirituality a science? I take it that science is a systematic body of knowledge, which builds on the achievements of numerous thinkers in order to erect a superstructure of thought that explains the phenomena of nature in an intellectually satisfying manner. The method of science is generally to state a hypothesis, which is then looked at experimentally and either verified or refuted. An important facet of this experimentation is that it should be capable of being performed by anyone at any time and should always yield the same result.

In my understanding, spirituality fulfils all these criteria. In fact, until we apply the theories propounded by the scientists of consciousness, life and nature appear to be meaningless and purposeless, the whole of creation appears to be an accidental agglomeration of particles that have somehow evolved in a certain mysterious manner to achieve certain uniformities and complexities that are inexplicable. It is spirituality, which invests the whole universe with meaning and purpose and shows us how the total is evolving and why.

Our problem is that we have placed these scientists of consciousness in watertight compartments that have no intersection or meeting point. It is as if we had several sciences of Physics named Platonism, Aristotelianism, Copernicanism, Newtonism, Einsteinism, Heisenbergism, Hawkingism and so on and divided humanity among those who followed one or the other of these versions of Physics. To carry the analogy further, this would mean that the Einsteinists would kill the Newtonists on the ground that Einstein had demolished the mechanistic model of the universe and enunciated the relativistic model.

The moment we see spirituality in this fashion, it will be immediately apparent to us that there are greater contradictions in the theories, concepts and formulae enunciated by the scientists of Physics than in those suggested by the scientists of consciousness. If we have been able to accommodate all the different models of reality within the covers of a single textbook of Physics, why are we reluctant to accord the same treatment to spirituality?

SCIENCE AND VIOLENCE

Let us see how science has fared without incorporating the insights of spirituality. We will look at science and violence, science and values, and science and purpose.

The rise of physical sciences has inevitably led to greater violence. Today, an overwhelming proportion of scientific research is devoted to the pursuit of violence, of how to manufacture more and more lethal weapons of destruction, of how to harness chemical and biological forces of nature so as to wreak vengeance on our enemies in ways that can only be characterized as inhuman and horrendous. There was a time when wars used to be fought among soldiers belonging to two warring tribes or nations. The soldiers used to be a microscopic proportion of the total population. Injuries and deaths would generally be confined to the righting forces and would not extend to the civilian population. Today, an atom bomb is not targeted at the armed forces of the enemy. It is trained at a city... a city teeming with millions of civilians going about their daily business of living... old men sunning themselves, children playing in parks, housewives in shopping malls. And it does not matter how you kill people. You can detonate a bomb or put poison into the water supply or generate nerve gas.

Why do scientists build these horrendous weapons? If you ask them, they give you a beatific smile and say that they are only inventing things because there is a certain thrill in exploring the boundaries of knowledge, and it does not lie in their province as to how the commercial or political exploitation of that knowledge takes place. A knife, they will say, can be used for surgery or murder. The scientist only makes the knife optimally efficient. Whether his fellowmen use the knives for constructive or destructive purposes is not his lookout.

SCIENCE AND VALUES

This attitude does not apply to weapons alone. One of the harsh facts of today's life is that human beings tend to agglomerate in huge urban complexes. Here they are packed like sardines within a few kilometers. They live in skyscrapers, in tiny flats where they can see neither the earth nor the sky. They cannot grow plants. They cannot sit out in the garden. They travel in overcrowded buses, trams, trains, metros and so on. They get bogged down for hours in monumental jams, where traffic moves by inches and raises blood pressures to dangerous levels. They live impersonal lives. They don't know their neighbours. All their friends live at far off places, where you can reach in hours, not minutes. Social intercourse is, therefore, zero. The children have nowhere to play. Everyone is cooped up in his bit of God's space and the only entertainment is television.

Why has this happened? It all started with science and technology leading to huge production on farms and inventing the factory system of manufacturing more efficiently. The result was that less and less people were needed on farms, and more and more people in the factories. There is a science fiction story in which the entire human population of the world is lodged in a single skyscraper, several kilometers high, several kilometers long and several kilometers wide. All transportation is through horizontal and vertical elevators. There is not a single human being in the farms. He is not needed. Mechanized aquaculture is totally automated.

Why are our aeroplanes becoming bigger and bigger? Is there a stated need for larger size? No. It is because scientists are capable of making larger and larger aeroplanes. It is not human need that drives technology. Technology now drives human effort. A bigger plane may be a liability in human terms. It will take longer to board and to disembark. More people will die in case the plane crashes. There will be longer queues everywhere from the booking office to the final entry into the aircraft. A plane journey will become as deglamourized as a bus journey or even worse. It is not the traveller who will decide the kind of aircraft he would like to travel in. It is the scientist.

If you ask the scientist, he will say that he is not concerned. Very early in its journey, modern science decided that it had nothing to do with values. Science was value-neutral. Scientists were only competent to say that if circumstances were like this, the results would be like that. It was not for them to say whether the results were good or bad. Good and bad were value judgements, which could be passed by-philosophers or the guardians of morality. But value judgements were declared to be outside the province of science.

The result is that the scientist could merrily pursue scientific inquiry for its own sake and let the devil take the hindmost. If from his scientific discovery, the further applications were deleterious or dangerous for society, it was bad luck! But the scientist would not, for this reason, slacken the pace of research.

Today, we can see this happening in the field of genome research. Many prophets of doom feel that some kind of catastrophe awaits humanity if it persists in playing with genes, producing clones and test-tube babies and tinkering with the genes to produce a new kind of human being. But these considerations are irrelevant for a scientist.

SCIENCE AND PURPOSE

At the bottom of his mind there is this strong conviction that life as such has no purpose. The scientist does not believe in God; he does not need Him as a hypothesis to prove any of his discoveries. He looks upon Nature as a self-directed or undirected conglomeration of particles, which creates different combinations with different attributes in accordance with certain mysterious laws that are not yet fully understood. In fact, he would object to the word 'laws'. There are no 'laws' or 'principles' guiding nature. There are only probabilities, which are infinite in number and which keep on changing all the time. If the evolution from amoeba has led us to man, it is not the achievement of some intelligent force, it is the chance interaction of blind natural forces which affect one another in accordance with statistical probabilities. It is just accidental that man got created. It could as well have been Tyrannosaurus Rex.

Now if this is our deep-seated belief then nothing in life can have a purpose either. Neither fatherhood nor motherhood nor teaching nor spiritual instruction nor knowledge nor the process of living can have a purpose. Anything can happen at any time. The universe may disappear at any time. Some obscure disease may wipe off life from the face of the planet.

The scientific attitude has, therefore, taken away meaning and purpose from people's lives. If everything is an accident, then anything can happen. It hardly matters what I do. What has to happen will happen. It is not that something happens because it is destined to happen. Once it happens, we can say that this was going to happen. So nothing is predestined or preordained or predictable. That is why the scientist has this tremendously strong gut feeling against all the bodies of knowledge like palmistry, astrology, numerology, tarot cards, clairvoyance and the like, that have any implicit assumption about there being a method to all this madness.

SPIRITUALITY: AN ALTERNATIVE WORLD-VIEW

Against this iconoclastic world-view of science, spirituality has an alternative model to offer. It postulates that there is a Cosmic Consciousness that guides and controls this universe, that only consciousness exists and everything else is a transformation of consciousness into increasingly gross forms like thought, emotion, energy and matter, that consciousness is not something that emerged out of the process of evolution as a byproduct but it is anterior to evolution, it is the very stuff of which everything is made. The interesting part is that consciousness is not blind or accidental or value-neutral or purposeless or meaningless. Consciousness is difficult to define but some of the attributes it is supposed to possess are awareness, perceptive ability, light, bliss, intelligence and creative dynamism.

The spiritual model states that the universe is a manifestation of Cosmic Consciousness, as a play of its dynamic energy, that the play is that of the divine with the divine, with nothing blind, irrational, accidental or probabilistic about it. It is a play like a drama, a play with a director, a script, actors and actresses, a plot, a climax, a denouement, the whole works. It is a play like a game, with its players, its rules and byelaws, its referees and umpires, its victories and defeats, its tournaments and championships, its triumphs and tragedies. Thus the evolution of man is not a haphazard light and bliss with some creative dynamism, with some degrees of freedom, to enjoy the phenomenon of co-creation and co-playacting.

Thus in this world-view of spirituality, meaning and purpose are restored to existence, the universe is no longer a dark maze of subterranean terrors but a warm, hospitable place where we are ensconced in the lap of the Divine Mother, playing with her in accordance with the ground rules that she has laid down, but with the comfortable feeling that she is there to tell us to desist where we are upon something dangerous, the world of values comes into its own as having a foundation and a basis, there is a possibility of guessing the future course of events as our mind learns gradually to get closer to the Cosmic Mind, and we are face to face with a seamless reality, where everything is holy, everything is sacred, everything is purposeful, because there is nothing outside God.

PART II

SCIENCE, SPIRITUALITY AND KASHMIR SHAIVISM

CHAPTER 14

SCIENCE AND KASHMIR SHAIVISM

By. Prof. Makhanlal Kukiloo

The conviction that the infinite, beginningless and endless consciousness is the real knowledge, can be acquired only through one's own right thinking and honest effort. No other agency than one's scientific outlook can bring this Truth home to one. The goal of all philosophical thinking is Truth, The Reason is the guide and the experience is the source. A sincere science student should keep always all the windows of his heart open to receive light from all directions but should not depend to any particular creed or scripture. If the scriptures make some statements which are illogical or irrational and against the values of experience, their authority is to be questioned. As is said *"ESA SARVAPADAA TEETO BODHAH SAMPRAPYATE PARAH*[1]*"*. This scientific knowledge is supreme and cannot be challenged. It is this scientific knowledge, that helps us to identify the self. The self is not shown to us by any scriptures or by any master. It is seen by one self through one's own knowledge acquired through one's own thinking. It is said *"SHAASTRAARTHAI BUDHYATE NAATMAA GUROR VACHANTO NA CHA BUDHYATE SVAYAMEVESA SVA BODHAVASATASTATHA*[2]*"* Thus the self knowledge, in the fullest sense, is the actual living in the absolute experience. It is complete identification with the Divine Being.

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1. एष सर्वपदातीतो बोधः सम्प्रायते परः।
2. शास्त्रार्थैः बुध्यते नात्मा गुरोर्वचनतो न च।
   बुध्यते स्वयमेवैषः स्व बोध वशातस्तथा।।

This self realization has scientifically been explained by Kashmir Shaivism. Kashmir Shaivism or Shaiva Systems is a more comprehensive term representing all the dualistic, non-dualistic, and dualistic cum non-dualistic systems evolved from *SHAIVAGAM* OR *SHAIVATANTRA*. Shaiva System means any system based on Shaiva Tantra or *AAGAMAS*. 64 Systems of Shaiva cult are mentioned in the Shaiva Scriptures of Kashmir which include *TRIKA* as one of them. *PRATIBHIJNYA* is the philosophical content of the *TRIKA*. It is so called by *UTPALDEVA* the originator of the system. *SOMANANDA* is the first to make a definately rationalistic approach to the problem of the untimate Reality. He clearly refers to the various prevailing schools of thought and rationally proves the unsoundness of their theories. He brings a radical change to the prevailing philosophical thoughts of the time. We can therefore say that it is *SOMANAND* who laid the foundation stone of new system known as the *PRATIBHIJNYA* school of Kashmir and not the particular philosophic tradition existed before his time. This Kashmir Shaivism is called *TRIKA* in Shaiva literature since it deals with the triple principle *SHIVA, SHAKTI ANU OR PATI PAASH OR PASHU OR NARA, SHAKTI AND SHIVA OR PARA, APARA, PARAPARA*on consisting of the three chief *AAGAMAS* namely *SIDHA NAAMAK AND MALINI* or *BHEDA, ABHEDA OR BHEDABHEDA* all the three systems teach threefold method of Agamic realisation.

When we ponder over the topic of today namely Science and Kashmir Shaivism, we are overwheled to find that the basic facts of Kashmir Shaivism are linked with the Scientific truths. First of all we take the theory of speech. In Physics importance of sound is known to all. This very sound is the basis of this theory of speech. Kashmir Shaivism defines four types of speach namely Para, Pasyanti, Madhyama and Vaikhari. Para means supreme speech. It is that soundless sound which resides in your own universal consciousness. It is the life of the other three kinds of speech. Pasyanti is that speech which is without differentiation. You will only see that there is some sensation of seeing. You will not see anything. It is experiencing, serving but not seeing anything. Madhyama Vak is 3rd stage. It is between the highest speech Pasyanti and the lowest speech Vaikhari. It is that state where you reside in thoughts only. It is only mental state. It is without words, sentences or letters. When we are asleep and dreaming we are residing in Madhyama Vak. Fourth state of speech is called Vaikhari.

It means gross rough speech. It is ordinary speech. Here we have to use our tongue and lips. These states sceintifically are called the supreme subtlest, subtle and gross. In fact it is said in our Shaivism that those who cannot enter into their real nature while listening to the sound of stringed instrument, have no capacity of concentration.

The theory of reflection is another scientific feat of Kashmir Shaivism. The students of physics are well versed in this theory of reflection. In Kashmir Shaivism it is called *PRATIBIMBAVAD.* As per this theory this universe is found in the reflector of God conciousness not through the agency of anything of which it is a reflection but through his absolutely independent will, when the universe is contained in a seed form. This theory of reflection is meant for advanced Yogis. This theory teaches them how to be aware in their daily activities while walking, tasting, smelling, touching, hearing etc. They see that all of these actions move in their supreme consciousness where limited becomes unlimited.

Kashmir Shaivism lays stress on the science of *KUNDALINI* the serpent power, which has been overlooked by other philosophies. Kundalini is in discussion everywhere today. Shaivism explains that by piercing of six wheels-the centres of energies, starting from *MOOLADHAR TO SAHASRAR*, one enjoys the supreme bliss, because this power is the revealing and concealing energy of Lord Shiva. Just as the energy of heat of fire and the energy of light are not separate from the fire itself, similarly the *KUNDALINI SHAKTI* is not different from the existence of Lord Shiva.

Much has been said about energy in scientific mannuals. It commands important place in this filed. In Kashmir Shaivism also energy has been discussed fully. Energy is named as Shakti. In the categories of 36 elements it is accepted as second element after Shiva It's manifestation takes place almost simultaneously with the first, because unless there be consciousness of what is manifested how can it be find to have manifested at all ? It is said :-

SHIVA SHAKTYA YUKTO YADI BHAVTI SHAKTAH PRABHIVITUM
NA CITED EVAM DEVO NA KHALU KUSHALAH SPANDITUMAPI[1]

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1. शिवः शक्त्या युक्तो यदि भवति शक्तः प्रभवितुम्।
न चेदेवं देवो न खलु कुशलः स्पन्दितुमपि।।

i.e. only if conjoined with Shakti Shiva would earn the privilege to become overlord, otherwise the God is not able even to stir.

In Shiva scriptures this energy is named as Vimarsha Shakti and Shiva is name as *PRAKASH VIMARSHAMAYA*. The Prakasha aspect however is not the most distinctive aspect of the individual self, because it is common to other things also, such as mirror, crystal, J well etc. If the individual self had been *PRAKASH MAYA*, it would have been not better than a substance capable of receiving reflection. The Vimarsa stands for the distinctive aspect of the self. It signifies the capacity of the self to know itself in all its purity. The point ...is very clearly been explained by Abhinava Gupta in his Pritikhijna Vimarsini. This very Vimarsa energy is spoken of as *SVATANTRYA* energy also because its existence does not depend upon anything else. Thus Vimarsa is that energy, that power which is ultimately responsible for keeping the universe in the state of perfect identity with itself at the time of destruction, and manifesting it as apparently separate from itself at the time of Creation.

The next basic topic of Kashmir Shaivism, in relation to science, is spanda school. Spanda means movement or viberation. Spanda Karika the only book on this school has three Nishandas means viberation. The first viberation goes by the name of the vitality in real nature. The second goes by the energy in the rise of intution. In third viberation goes by the energy in and of Glory of Spanda. According to this school nothing can exist without movement. Where there is movement there is life, without it there is lifelessness. Some scholars are of this opinion that spanda tattva exist even in wakefulness, dreaming, deep sleep and Turya state also. As is said in Spanda Karika of vasu Guptanath.

TASYOPLABDHI SATATAM TRIPADAVYABHICHARINI NITYAM SAYAT SUPRUBUDHASYA[1]

in an important Shaiva text "Shattrimsat Tattva Sandoha Spanda is described as Shiva Tattva highest Divine power.

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1. तस्योपलब्धिः सततं त्रिपदाव्यभिचारिणी।
नित्य स्यात् सुप्रबुध्दस्य.............

YADAYAM ANUTTAR MURTI NEJECHEYAA AKLHILAM IDAM JAGAT SRASTUM PASPANDE SA SPANDAH SHIVTATTAVAM TAJGNYAI[1].

Thus about the establishment of Spanda principle Vasgupta says that one who is extremely exasperated or the one who is exceedingly pleased, or the one who is deeply considering what to do, or the one who on seeing the lion or on seeing the venamous snake, is running helplessly to and fro, is being established in Spanda principle there and then. More so even in the walking state one who is always in readiness to have the clearvision of Spanda principle realized his own nature very soon.

To sum up this Spanda it is said

SPANDAATMAKAM IDAM VISVAM SPANDAATEVA PRAVARTATE
SPANDAYA SPAND GARBAAYA SHIVAH SARVAM PRACHODAYAAT[2]

Means this whole universe is in the form of Spanda, this whole universe has emanate, from spanda, this universe is nothing but Spanda may this divinepower direct all seekers on the right path of emancipation.

This Spanda literature which grew on the basis of *SHIVA SUTRA* do not represent any mannual of philosophy as the *PRATYABHIJNA SHASTRA* does. It may pointed out that Spanda branch of Trika has for its main subject matter the three mystical ways to the realization of the divine power i.e. *SHAMBAVA, SHAKTA* and *AANAVA*. They are mere dogmatic statements of the fundamental principles of the Spanda system.

Vigynan Bhairva is very important Shaiva Agam scripture. It explains 112 Dhamas - the yogic feets one by one . All these 112 Dhamas are fraught with scientific truths. As per medical science we are breathing in and breathing out 21600 times in 24 hours. In Vigynan Bhairva it is said that we are reciting sacred mantra

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1. यदयं अनुत्तरमूर्तिः निजेच्छया अरिवलं इदं जगत् सष्टुम्।
पस्पन्दे स स्पन्दः शिवतत्त्वं उच्यते तजज्ञैः।।

2 स्पन्दात्मकं इदं विश्वं स्पन्दात् एव प्रवर्तते।
स्पन्दाय स्पन्दगर्भाय शिवेः सर्वं प्रचोदयात्।।

unintentionally during this process because when we breath out we produce the sound of 'Sa' and when we breath in we produce the sound of Ha. In this way"we are recitng Sa, Ha or Hamsa mantra which by constant reciting takes the form of Soham or Hamsah in reverse form. This sort of reciting mantra is called Ajapa Gayatri the highest form of recitation. But it is shoking that we are unaware of this Mahamantra. When we will attach awareness to our each and every breath we would realize our own nature instantly. This is our common way of entering into god consciousness. There are other numberless scientific ways, described in the above said book which are helpful for realizing our true nature.

Science of Recognation is the supreme aspect of Kashmir Shaivism. It is called here as Pratyibhiyna Darshan. This principle has been explained by Shri Somananda of 8th Century A.D. This is highest approach to reality and is applicable to those aspirants who have the highest ability. Acarya Utpaldeva in his own commentry called Ishwar Pratiyabhijna Vimarshni quotes a typical example of Pratiyabhijna. He says

TAISTAI APYUPYACHITAIR UPNATAS TANVYAAS STHITO PYANTAKAI

TO

TAT PRATYIBHIGNYODITAA.[1]

For example there is a damsel, whoes marriage has been fixed with some one having excellent, domestic qualities, educational background and other achievements Without knowing or seeing each other they become day by day more and more impatient for their would be relation. Accidently both are present at a place of pilgrimage but are having least impression of their relation. Without yielding any excitement the meeting ends. Suddenly some one knowing both of them and their would relation comes and reveals their identities. On hearing this their heart blooms with joy of love, their mind and bodies experience unparralled situation and both rejoice the occasion, like never before. Likewise uptaldeva says that

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1. तैस्तैरण्युपयाचितैरूपनतस्तन्वया: स्थितोण्यन्ति के
....तत्प्रत्यभिज्ञोदिता ।।

a sipiritual guru provides the necessary inspiration to an earnest aspirent at the spur of the movement which enables him to know the self which already he knows but is unaware of it. This is how the principle of Pratibhijna operates.

Lastly I would like to say that a theory of time and a theory of 118 worlds too has been scientifically illustrated by Abhinavgupta in his gigantic treatise namely "Tantraloka". The dyoen of Kashmir Shaivism Abhinavgupta of 10th/11th century A.D. was greatest exponent of the philosophy of Shaivism which lays more stress on practice then to logical discourses. Apart from Abhinavgupta's erudition as a philosopher and being a versatile genius his contribution to Indian thought is remarkable.

To sum up "science is able to investigate for example the external nature and behaviour of the atom, but the practice of meditation bestows omnipresence. Yogi can become one with the atom".

CHAPTER 15

REFLECTIONS ON SCIENCE AND SHAIVISM

S. S. Toshkhani

My acquaintance with the history of Kashmir Shaivism began rather early when as a child I was shown by my father a photograph of the spot on the Mountain where the Shiva Sutras are believed to have been revealed to the sage Vasugupta in the beginning of the 9th century. He also showed us a photograph of the cave at Beerwah which the great Abhinavagupta is said to have entered along with twelve hundred of his disciples chanting his favourite hymn to Bhairavanatha "vyapta charachar bhava vishesham" never to come out again. My father's shelves were full of Kashmir Shaiva texts which he would study at times despite being an ardent believer in the philosophy of J.Krishnamurti. It was in fact to explain a point made by Krishnamurti that he, some years later when I had just entered the threshold of youth, referred to an aphorism from the Shiva Sutras - gyanam bandha - meaning that limited knowledge is bondage. His reference to this sutra aroused the curiosity in me to know more about this basic text of Kashmir Shaivism which I found to be unique in many ways. I, however, graduated to a maturer understanding of Kashmiri Shaivite thought, of course as a layman, only after I managed to free myself from the influence of Western existential philosophy which held a pervasive sway over my mind throughout the 1960's and early 1970's. I felt that existentialism, with its stress on the futility and meaninglessness of living in a Godless and valueless world and its suggestion of suicide as a way out, to be too depressing, while Shaivism with oneness of existence as its core concept seemed to offer a new insight into the nature of things. "Chaitanyam atma", or consciousness is the self, says the first sutra preceding the one quoted by my father, referring to individual a well as the universal soul and emphasizing that consciousness is indivisible. To me the sutra seemed to be brimming with answers to some of the fundamental questions of existence which "men and women have asked in all ages, and which they are asking today".

With my curiosity aroused, and my interest having become more serious, I ventured a little deeper into in to the new realm of thought that had now opened up for me and found Kashmir Shaivism to be a most revolutionary philosophy, more intellectual than many so-called modern schools of metaphysical thought. It relies on intuition for direct experience of reality and also uses reasoning and profound argumentation to teach its doctrines. What is more, and this is what I am going to touch upon in my paper today, it offers a world view that happens to have striking similarities with the one that emerges from contemporary scientific thought, in particular modern physics. Inquiring into the nature of reality, physicists of today are displaying an increasing tendency towards a mystic or spiritual interpretation of reality instead of insisting that only material things are real and dismissing religious experience as wandering in "a world of shadows". Like other schools of Eastern mysticism, Kashmir Shaivism presents reality as one and indivisible, emphasizing the fundamental unity of the universe and mutual interrelation of all things and rejecting the notion of a nature divided into separate objects existing apart form the absolute.

This unity in Shavite view, however, is integral and organic with everything having a place "in the economy of the whole". The Shaivite's insistence that the absolute is not only self-subsistent or free (svantantra) but also all-inclusive (purna) "allows for the existence of the world of objectively perceived phenomena along with the pure subjectivity of the consciousness", the two representing opposite polarities of a single reality, to use the words of Mark Dyczkowski. "The one is not any one thing because it is all things", Dyczkowski explains quoting Abhinavagupta. Thus the Supreme Reality or Parama Shiva as the Shaiva philosphers call him, underlies everything in the world but is beyond all limitations of time, space and form. He is immanent in and yet transcends everything, manifesting Himself as the phenomenal world and at the same time remains unaffected by this manifestation. This creative power of Parama Shiva, called Shakti, is in no way different or separate from Him. Indeed, the entire universe with its infinite variety of objects, is nothing but the cosmic expansion of Pit is the one Parama Shiva in His aspect as Shakti. It is the one reality, therefore, which manifests itself as many. "There can be no real unity unless diverse elements are united in the wholeness of totality", points out Dyczkowski. " On the other hand, without unity diversity would be unintelligible".

If Kashmir Shaivism looks at the cosmos as one indivsible and integral reality with everything related to everything else, modern science too appears to have reached conclusions which present the world as "a system of inseparable, interacting and ever-moving components with the observer being an integral part of this system", to quote Fitjof Capra, a well known physicist whose best-selling book "The Tao of Physics" created quite a sensation when it was published some years back. Pointing to the similarities between the concepts of contemporary physics and those of Eastern mysticism, Capra write: "The basic oneness of the universe is not only the central characteristic of the mystical experience, but is also one of the most important revelations of modern physics. It becomes apparent at the atomic level and manifests itself more and more as one penetrates deeper in to matter, down to the realm of sub-atomic particles As we study the various models of sub-atomic physics we...see that they express again and again, in different ways, the same insight - that the constituents of matter and the basic phenomena involving them are all interconnected, interrelated and interdependent; that they cannot be understood as isolated entities, but only as integrated parts of the whole".

It was in the early decades of the 20th century that two revolutionary developments shook the entire conceptual framework of 19th century materialism based on the mechanistic world view of Newtonian physics—these related to Einstein's theory of relativity and the quantum theory. Both these theories brought radical changes in scientific thinking and necessitated new conceptions of matter and energy, space and time, cause and effect subject and object. New probes in to the atomic and sub-atomic world demolished the view of atoms being hard and solid objects of matter revealing instead that they consist of extremely particles - protons and neutrons and a nucleus of electrons occupying large spaces. Quantum theory showed that even the sub-atomic particles of matter exist as very abstract entities. Not only that but that they have "tendencies to exist" sometimes as particles and sometimes as waves - not the real three dimensional waves like waves of water but probability patterns associated with mathematical quantities. Again these too cannot be understood as isolated things but as interconnections between things. As Heisenberg, one of the architects of quantum theory put it: The world thus appears as a complicated tissue of events in which connections of different kinds alternate or overlap or combine and thereby determine the texture of the whole". One of the crucial features of quantum physics is that the observer is not only necessary to observe the properties of an atomic phenomenon but for determining these properties. Human consciousness thus plays a very important role in the observation processes invalidating the idea of objective description of nature. The implications of this new reality were suggested by Max Planck, yet another architect of quantum theory, long back in these words: "I regard consciousness as fundamental. I regard matter as derivative from consciousness. We cannot get behind consciousness. Everything we talk about, everything that we postulate as existing requires consciousness".

Consciousness is a concept on which the entire structure of Kashmiri Shaiva metaphysics also stands. "One could almost describe it as a psychology of absolute consciousness", says Dyczkowski. Using the symbolism of light the Pratibhijna or Recognition School of Kashmir Shaivism describes the ultimate reality as prakasha and vimarsha—the Divine light of Consciousness and its "reflective awareness" together as all-pervasive and all-inclusive fullness. It is the Light of Consciousness that makes everything appear as real or unreal and helps us to grasp the inner relationship between things as "integral parts of the absolute in static juxtaposition and mutual interpenetration".

Modern science and Kashmir Shaivism both realize that the "cosmic web" of interconnections and interrelations is dynamic, active and alive and not passive and inert. According to the Kashmiri Shaiva everything is sentient, not even a stone being dead matter. And that is precisely the position that quantum physics also takes. It pictures nuclear-sub-atomic- structures as always in a state of motion. When they are confined, the sub-atomic particles react by moving around the space that confines them. The infinite variety of molecular structures that atoms form when they link up with each other keep vibrating continually showing how full of activity they are - their velocities being almost as tremendous as the velocity of light. In Shaivism, aspects of the dynamic consciousness that pervades the universe as its underlying reality are explained in terms of spanda shakti or the vibrating power that generates change. Explaining the concept Abhinavagupta says : "By vibration (spanda) we mean subtle movement. It is subtle in the sense that although it moves not, it manifests motion".

Einstein's theory of relativity brought about one of the greatest revolutions in the history of science making us recognize that spatial as well as temporal specifications are relative and depend upon the observer. Space, according to the theory is not absolute nor is time as in Newtonian model, but are connected to each other in what has been called "a four-dimensional space-time continuum". We cannot talk about space without talking about time nor can we talk about time without talking about time simultaneously. Experiments in particle physics have shown that particles can move backwards and forward in time. This brought about a profound modification in over concepts of time and space which are so vital for our descriptions of nature. Equally far-reaching was the consequence of this modification which revealed that matter is nothing but a form of energy, the relation between the two given by his famous equation E=mc, c being the velocity of light. In Indian philosophies time and space form a central feature both being always spoken in the same breath. For the Kashmiri Shaiva they are but limitations imposed by the Person on himself, kala and niyati, along with other three limitations. Although change is manifest in the cosmic process, and it is the basis of time, the absolute consciousness "is not divided by time or set in space".

A new paradigm is today emerging in scientific thought and this paradigm seems to be inclined towards a spiritual interpretation of the cosmic reality. Viewed in this context the modem world view of physics is complementary to the one presented by Kashmir Shaivism.

CHAPTER 16

SCIENCE AND KASHMIRI HERITAGE*

Professor S. Bhatt**

INTRODUCTION

We are living in an age when human knowledge is expanding fast With the globalisation of economies and culture, there is globalisation of knowledge. Even the study of science has become interdisciplinary. Stephen Hawking says in his book *A Brief History of Time* that the 18th century philosophers considered the whole of knowledge in one perspective. The philosophers of the 19th and 20th centuries, however looked upon science as a mathematical and technical subject. It seems that scholars in the 21st century have again started looking upon knowledge as one whole subject for analysis and study.

This paper deals briefly with the relationship of science with the ideas contained in the Kashmiri heritage, a heritage full with ideas of intellectual, social am philosophical content. Indeed we should not shy away combining ideas of science with humanism. Put together they determine the phenomenon of life itself. I have for my reference a Jawaharlal Nehru Memorial lecture delivered by a Noble-laureate in physics Professor Ilya Prigogine in 1983 entitled "Between Time and Eternity, Nehru an Einstein, which throws some light on science and Kashmiri heritage. I am also keen to refer to a symposium held by UNESCO on the 10th death anniversary of Einstein am biologist Chardin wherein an attempt is made by scholars to describe the role of Einsteii and Chardin to synthesise scientific knowledge for human benefit.

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VIEWS OF PROFESSOR ILIYA PRIGOGINE

Before I discuss science and Kashmiri heritage I wish to point out the Philosophical views on science put forth in recent years by Professor Iliya Prigogine who as a physicists, has made new revelations on man new understanding of nature. In his Jawaharlal Nehru Memorial lecture he says that in the beginning of 20th century the study of science was considered based on deterministic and reversible laws of universe. But today the interest is on non-equilibrium systems based on irreversible laws of nature. The aim of his lecture, as he said, was to attempt a synthesis of humanism and scientific spirit. In his book along with I. Stengers entitled *Order Out of Chaos,* Prigogine makes a vast synthesis of reversible and irreversible time, disorder and order, physics and biology, chance and necessity. Prigogine says of modern science philosophy that a new reconceptualisation of science is going on with a new dialogue of man with nature. He says we have moved to probability from deterministic thinking. Time, he says, is important for understanding history and nature. He feels that in the understanding of universe, and for world order, science can help create bridges and reconcile opposites without negating them. Nehru, according to Prigogine, was a man of history who had a good grasp of nature and world society. He was optimistic compared to Einstein. He had faith in the whole of mankind. All these traits, as we shall see later, reflect the philosophy and harmony of Kashmiri heritage.

A NEW PARADIGM HAS EMERGED: A BIOLOGIST VIEW OF WORLD

A new dialogue with nature has emerged with a biologist view of world in recent years. This has been a grand success of science and synthesis of knowledge on the one hand, and on the other a new vision of independent world has emerged when mankind is a considered as one species - Homo Sapiens, living in harmony with nature and natural environment. There is no disregard of physics which discipline was supreme until the time of Einstein who died in 1955. It is now bio-physics or bio-technology, subjects unheard of in my college days in 1948. The global environment movement was started by the United Nations Declaration of 1972. Its report was written by the synthesis of knowledge of biology by a renowned scholar and biologist, Rene Dubos, and an economist of global stature, Barbara Ward. The report entitled *Only One Earth* is a reminder to mankind to seek limits of economic growth and establish harmony with nature. In India, many scientists helped this new paradigm to grow. These included Dr. B.D. Nag Choudhuri, a physicist with whom I worked and produced a book *The Global Environment Movement* in 1986. Dr. T.N. Khoshoo and our distinguished speaker of this seminar, Professor M.G.K. Menon, have lent their ideas to promote the environment movement in India and a synthesis of many social and scientific disciplines. An ecosystem approach to natural resource management is one of the leading norms of this movement. Dr. T.N. Khoshoo elaborated the concept of sustainable development in his Presidential address to the Indian Science Congress in 1986 in which the theme of the Congress was science and environment management. How much can nature take was the theme of Dr. Khoshoo's address. It may be said briefly here that the scientific revolution contained in the global environment movement seeks harmony of man with nature, harmony among people of the world, a multi-cultural world, unity in diversity of global life, conservation, and a new vision of science and spirituality. Julian Huxley, the noted biologist and former Chairman of UNESCO said in the UNESCO symposium on science and synthesis (proceedings published in 1971, New York) that present day science needed synthesis. Rene Dubos said that there was need to search for reality and natural order. Arthur Waddingdon said that to understand the phenomenon of life was important for science. Many noted physicists like Seaborg have looked for new level of excellence in physics and technology and new integration between them. Seaborg has been keen to seek the unity of science all along, as Einstein too. Darlington, the biologist, even goes further and wants to see connection between biological principles and historical principles. I have myself attempted a synthesis of international law and ecology in my various publications in India and abroad. Today ecology is a universal norm. It is defined as a relationship of living organisms and their adaptations to environments. This is more or less also the definition of present day international law which governs global relations.

SCIENCE AND KASHMIRI HERITAGE

Today we have in this seminar an attempt being made to provide a synthesis of ideas of science and Kashmir heritage. We have distinguished scientists present from various disciplines to explore their views on science and scientific research which shapes modern global society. We have also some outstanding scholars from Kashmir who present their ideas contained in Kashmir heritage. A careful comparison will help us realise that in philosophical terms Kashmiri heritage follows many scientific principles of global environment movement of our time. Kashmir Saivism, for example, makes an attempt to seek reality by comprehending harmony with nature, and developing pure consciousness. Even Einstein has said that pure thought can grasp reality as ancients had dreamt. Mr. M.K. Kaw refers to man's quest for dynamic equilibrium through pure consciousness. Mr. Virender Qazi also refers to Saivism as a means to achieving pure consciousness.

Besides, Kashmiri philosophical heritage stands for global harmony, harmony with nature, harmony of being and non-being which Lal Ded, the greatest seer from Kashmir refers in her Vaaks. Kashmiri heritage stands for mysticism all along in history as mysticism in present day world has gained new level of excellence in science as well. As Einstein has said: "The fairest thing is the mysterious; it is the cradle of true art and true science." Therefore, Kashmiri heritage in general and Kashmiri Pandit heritage in particular holds mysticism in highest excellence. Thus we are proud of our saints and sages who make up for our brightest assets of intellect and spirit. The world looks for a new level of combination of science and spiritualism. Some great scholars like Mr. Vaslav, the

President of Czechoslovakia, have said that such a synthesis can be achieved by post-Einstein probability science philosophy and Eastern mysticism. Therefore, Lal Ded Vaaks and Kashmir heritage need extensive scholarly attention for the new excellence to be developed world over. Our scientists may think on such major issues of our civilisation. In this context, we are reminded of Professor E.C.G. Sudarshan's Jawaharlal Memorial Lecture on "Physics as a spiritual discipline". In this lecture, the relationship between spirituality and the scientific discipline is very well explained by Professor Sudarshan who is a world class scientist from India. I suggest therefore that we analyse our subject of Science and Kashmiri heritage in-depth. We may come across scholars like Abhinavgupta whom Professor Paul Muller from USA has recently described as the greatest genius that India has produced.

CHAPTER 17

SCIENCE AND KASHMIR SHAIVISM

Mr. Virender Qazi

We are analyzing a unique subject: the synthetics of natural sciences with metaphysics. Our ancient seers and sages long back conceived the principles of physical or natural science. The World, as we see, is a play of energy, force or vibration, and not an illusion, was an important creed of our Sastras. This is in total conformity with modern science.

Discovery of modern physics that matter is only waves of various lengths, without their being any essentially solid, hard stuff is really a re-discovery' of what the Trika Shastra conceived centuries ago as the "Spanda". Through modern physics, we have grown accustomed to thinking of physical reality as waves of energy—as the matter-energy continuum. Tantric Shaivism presents the full matrix of energy pulsation of which physical reality is only a part. From the relatively superficial perceptions of the senses to the progressively subtle forms of inner awareness, a unified spectrum of spanda leads inward until the most delicate and powerful tendrils of individuality merge with the infinitely rapid vibration of the ultimate consciousness.

Well, before we analyze further the physical and spiritual science, let us understand in brief the uniqueness of Kashmir Shaivism. This philosophy occupies a distinguished position among the various schools of religious creed and thought. It focuses on relation between God, Nature and Man, which overcomes all the barriers of diverse human-cultures. It leads to the highest level of self-realization, revealing the inner most secrets of the nature of self. All the aspects of life are integrated and taken in totality. Thus, rather than negation and denial, it celebrates life. Kashmir Shaivism is the school of Indian philosophy, which can inspire us for both material and spiritual progress. Rather, the approach is from theory to practice. Indeed, it leads us to the real" Art of Living".

Kashmir Shaivism is presently evoking deep interest in West, with lot of pioneering research work at leading universities. In our present strife-torn world this philosophy can be a great guide and uniting factor. A thrill of self confidence, the spirit of bliss, surpassing all barriers of caste, creed and gender, no look back, no regret, the inner journey, see everything as creation of God, etc - how prominently and conceptually these are emphasized in Kashmir Shaivism. In fact, it should be our endeavor to present this ancient philosophy in common man's language so that resurgence takes place with the goal of upliftrnent of world as a whole.

The prime focus of Kashmir Shaivism is on the Ultimate Reality called Param Shiva. This basic point is to recognize this source from which emanates everything and into which merges everything. Param Shiva is beyond description, beyond all manifestation, beyond limitation of form, time and space. He is eternal, infinite, all pervading, all knowing and all-powerful. In fact, this reality is ineffable and beyond all descriptions.

After our stress on this basic reality called Param Shiva, let us seek and understand this philosophy. Kashmir Shaivism is a process of recognizing or discover.' of individual soul as one with the Universal Being through correct knowledge of the "Descend" from Godhood to manhood. The next is "Ascend" or going back to Godhood. Lastly great stress is given to "Devotion" towards the Ultimate Reality called Param Shiva.

As regards the Great Descend, Kashmir Shaivism postulates 36 categories or "Tattvas" to explain the process of cosmic evolution or universal experience, i.e., from God hood to veiling or obscuring force of nature called Maya Shakti leading to various psycho -

physical elements and finally the Panch Mahabhutas - five great elements: Earth, Water, Fire, Air and Ether.

The first outward manifestation of the divine creative energy is called "Shiva - Tattva". It is the initial creative movement of Paramasiva and is support of all things in the manifest world, like the canvas of a painting. Next, the "Shakti-Tattava" is active or kinetic cosmic energy that effects the divine consciousness into action.

"Maya" is the veiling or obscuring force of nature that creates a sense of differentiation. As such, it makes universal consciousness, which is unity, appear as duality and multiplicity. The result of the limitation of Maya is "Purusha" and "Prakriti", the limited being and his nature. Here the dual world of mind and matter is permanently established. This follows various mental operations, ascertaining intelligence, sense perceptions, ego, etc. The process is complete finally with the gross Panch Mahabutas as referred above.

Now, let us consider the Ascend or going back to Godhood. What is source of pain and frustration- duality and moving away from Godhood! So. it is natural that we must strive to go back to Godhood. For this there has to be Shaktipath- the descend of Divine Grace. In order to earn Grace, one has to undergo spiritual discipline, known as "Upyas" or Trika Yoga. Depending upon potential of individual, these means or yoga have been categorized with particular emphasis as Anupaya (supreme means- Bliss), Sharnbopaya (higher means-Will), Shaktopaya (medium means-Knowledge) and Anvopaya (inferior means- Action). However, it must always be remembered that descend of the Divine Grace-Shaktipath- is independent of human efforts.

Kashmir Shaivism emphasizes that one has to discover the inner "Bliss". Let us not suppress the senses; do not torture the body or mind, etc. Forcible control will lead to adverse effect. Be as you are. When one discovers inner bliss he/she will give up fascination for outer worldly enjoyments. Outwardly one may perform the age-old traditions but inwardly he/she has to seek exact truth through the practices taught in Trika Yoga. There is no restriction based on color, creed, gender, etc. in eligibility for initiation in this Yoga.

As regards "Devotion", it is an essential aid to all the practices. An aspirant not blessed with devotion for the Lord can not succeed in the practice or Saivayoga. After inculcating the principles and treading the path as explained above, we should surrender and submit to the.Ultimate Reality. This will, no doubt, lead us to the ultimate goal

Coming back to great "Descent", the in-evolution or movement from Godhood to manhood or the great creation, let us analyze it in detail. What is the cause of the first movement or the impulse to create?

Sankhya says that it is due to the association of purusha and prakriti, but no reason is given for this association. Vedanta contends that only an intelligent agent can set Universal Consciousness in motion; so it postulates Brahman or the supreme lord. Both systems show where the initial impulse originates, but neither explains why. Kashmir Shaivism answers this question by saying that consciousness eternally alternates between two phases, rest and action, that is, Prakasha and Vimarsha.

The Prakasha phase is a period of potentiality, technically called pralaya or reabsorption. It is the passive phase of consciousness. Here all the forms of the manifest universe are dissolved and their essence re-absorbed by the universal consciousness. During the period of potentiality, pralaya, all manifestations are dormant just as the characteristics of a mango tree are dormant in a mango seed. After this period of latency, the universal seeds begin to germinate and consciousness becomes active.

The active phase of consciousness is called srishti or the creation of the universe. This phase of manifestation is also called abhasa. Each phase of action is said to generate the seeds of potentiality that germinate during the period of rest to bring about the next phase of action, in the same way that the flowering of a mango tree produces the seed for the growth of another tree.

The philosophy of Kashmir Shaivism, especially, the process of creation can be better understood by a careful study of this spanda principle. Spanda is the energy that permeates the universe during its processes of evolution, vibration, and the ceaseless force from which springs everything that exists. It is the source of universal energy which manifests itself in fear, joy, and anger, and which throbs in word and thought. When a person is overwhelmed with ecstasy, joy or anger he experiences Spanda. Spanda is the supreme universal power, which embodies all manifestations. It is the first motion of will, the impetus of spirit.

In the Kena Upanishad a student asks his teacher, "who directs the mind towards its object? Who causes the prana or life force to function? Who compels men to speak? What God makes the eyes and ears function?" The teacher answers that the Ultimate Conscious Force or Spanda is the source of all actions, emanations, illumination, and unfolding; but it remains unattached to all these. Furthermore, it is by means of this Universal Conscious Force that the eyes see, the ears hear, the mind thinks, the intellect grasps, the metabolism works, and the planets move.

The power of Spanda is the dynamic aspect of the transcendental Reality. This Reality is the abode of all powers of manifestation and action. Through introspection, an aspirant can experience the inner motive force of Spanda. Abhinavgupta, the great master of Kashmir shaivism, observes that Spanda is unobjectified desire, which leads consciousness to feel incomplete. It is the first stage of consciousness before it crystallizes into the reasoning process.

Though Spanda is expressed in various ways according to the particular movement in which it manifests, Ramakantha, the author of a commentary on the Spandakarika, has used it in the special sense of an inner rhythm of aesthetic spiritual experience. This may be characterized as a flash of thought or an inner perception such as pleasure or pain. He also uses it in the sense of an unobjectified desire.

All action merely represents an expression of the individual's will. Immediately before beginning an action, one experiences a kind of stir within. Wordily action is therefore a unity because of the oneness of will and purpose. Spanda is the first 'flutter of Pure Consciousness in the process of the five fold actions: emanation, existence, dissolution, concealment, and bestowal of grace.

Spanda cannot be understood by intellectual interpretations of metaphysical ideas. It can only be grasped through introspection. One can observe within oneself the various changes that take place in the satisfaction of a wish or desire.

Spanda is that power of consciousness that infuses life into physical senses, which would otherwise appear inert. A person who observes his own nature can comprehend that power. Spanda animates the senses and is the origin of the processes of creation, existence, and dissolution. Every natural phenomenon is brought about by this same power. An individual can watch his thinking process as well as the various steps involved in the fulfilling of a desire and thereby observe Spanda at work.

When a person is thinking of one aspect of an idea, another aspect of the same idea suddenly arises in his mind. In this process, the junction-point between the two thoughts is called unmesha. Modern scientists put it in their own terminology. They call it an altered state of consciousness or a state of higher consciousness. They say that everything in the universe functions like a pendulum, which moves from one point of rest to another. In other words, all matter vibrates. This point of rest is very dynamic in that it is where the change of direction takes place. At that point it actually disappears for a fraction of a micro second and then reappears. This means that we have a system in which all our realities exist on an off-on basis. During the off period we expand and fill the entire universe; the we contract and continue in our normal reality as if nothing had happened. It is not the physical object that expands but rather it is its essence that extends to fill the universe.

A seeker should become familiar with this junction point, which is the background of all his thoughts and images. Here he can experience the conscious force that brings about the sudden change from one image to another. The various images are fleeting; but their source, which pervades them all, is unchanging.

Now, let us stress again on the natural sciences. Let us take a voyage through the history of the Universe, as we currently believe it to have been. At that instant, from nothing, a tiny speck of infinitely hot light appeared. This is the event referred to as the "Big Bang." Inside the speck was all of space. The fireball began to expand. In one trillion-trillionth of a second, the Universe grew a hundred million times bigger; its temperature dropped from near infinity to about 10,000 trillion trillion degrees. Electrons and positrons formed, immediately annihilated, and repeated this cycle over and over.

In practically no time, a vast expansion of the size of the Universe took place and the temperature became such that real matter, particle and anti-particle pairs could form and go their separate ways. The Universe entered into a period of frenetic matter creation, which lasted about a second. When the frenzy was over, matter had won out over antimatter. However, protons, neutrons, and electrons were only a minute constituent of the Universe.

Eastern wisdom defined thousands of years ago the concept of Spanda, as a vibration or flashing forth of the Divine Consciousness, as being the fundament of the entire manifestation of the Universe. In this vision, consciousness is everywhere, even in the most insignificant particle of matter. In other words, the whole matter contains consciousness (therefore, life) in various proportions. In the smallest measure, all that we know and have known, are fragments of our being. Within everything and every one, there is a tiny tiny vibration.

Sir James Jeans said, " *The universe starts to look more like a great thought, than a great machine.*" Spanda is the vibratory dynamism of the absolute consciousness.

LALLESHWARI - HER SPIRITUAL GEMS

While expounding the relevance of Kashmir Shaivism our deepest gratitude goes to Lalleshwari, whose teachings *give a unique opportunity to have insight into this mystic philosophy. She conveyed its essence in a simple way for benefit of the humanity.*

She had a vision -- of past present and future! She could see beyond times; right from the formation of Universe. She saw Kashmir valley out of vast lake, a great expansion of water, surrounded on all sides by mountains. After this vision of the past she could see the present - her times. She could narrate the woes and turbulence permeating her life and the society in general.

Let us conclude with her mystical outpourings, the Lal - Vakh.

THE EARTH AS A TINY DOT BUT FULL OF LIFE AND OTHER MANIFESTATIONS.

Yath Saras sariphol na vetse,
Tath sari sakalay poni cen;
Mrag, sragal, gandi, zalhasti,
Zen na zen ta totuy pen.

What a surprise! This earth looks like a lake so small, in which a mustard seed cannot be contained,

But from this very source or lake all (the sakala) drink water;
The deer, the jackals, the rhinoceros and the sea-elephants,
Are no sooner born than they fall into it (The life cycle).

THE MYSTRY OF LIFE FORCE - THE PRANA.

He guru Parameshwra,
Bavtam tseyi chuy antar vyod;
Dwashavai vopadan kanda-pura,
Hah kava turun ta hah kava tot?

She asks her Guru to solve the riddle. O my teacher! Thou art as God to me!
Explain thou to me, for the inner meaning (or the difference) is known to thee;
Both the breathings take their rise from the region of the Bulb:
Why then is 'hah' (short breath) cold and 'hah' (long breath) warm?

Nabhisthanas tsit zalavani
Brahmasthanas shishirun mwakh,
Brahmandas chai nad vahavani
Tavai turun 'hah','hah' gav tot.

The region of the navel is glowing with fire, by its very nature, The hot air rises up to the throat which is the passage for inspiration and expiration, But, from Brahmanda there is a cold stream flowing downwards, The short breath is cold, therefore, and the long one is hot.

On the subtle plane, the coolness of short breath and the warmth of a long breath are related to two facts accepted by the yogis. The navel region or ' kanda-pura' is the region of the sun where the abdominal heat glows perpetually. The long expiration is said to get warmed up by the heat of the bulb at the navel.

Against this, the yogis also assert the presence of the microcosmic Moon in the Brahmarandhra or the upper extremity of the susumna nadi. The region of the Moon being cold, by its very nature, gives out a cold current down the Susumna. This current cools the breath as it is carried by Ida nadi or Candra nadi in short breathing.

CHAPTER 18

REFLECTIONS OF A PHYSICAL SCIENTIST

P. K. Kaw

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INTRODUCTION OF AUTHOR

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Present Position, including Honorary position

Director of the Institute

Fellowships, Awards, Prizes etc.

Institution/Academy/Society	*Award*	*Year*
INSA	*Young Scientist*	*1974*
I.A.Sc.	*F.A.Sc.*	*1974*
American Physical Society	*Fellow*	*1980*
INSA	*Fellow*	*1984*
Govt. of India	*Padma Shri*	*1985*
CSIR	*S.S.Bhatnagar Award*	*1986*
National Academy of Sciences	*Fellow*	*1987*
Ghent University, Belgium	*Doctor Honoris*	*1991*
IIT, Delhi	*Distinguished Alumni Award*	*1992*

Other Distinctions:

- *Member, International Fusion Research Council, IAEA, Vienna (1986-todate)*
- *Chairman, International Fusion Research Council, IAEA, Vienna (2000-03)*
- *Associate and Corresponding Member, ICTP, Trieste, Italy (Past)*
- *Associate Editor, Jr. Plasma Physics (Cambridge) (1994-todate)*
- *Past editorial assignemets: Editorial Board, Plasma Physics & Controlled Fusion, I.O.P. U.K. (upto 1997). Correspondent, Comments in Plasma Physics, Physics News, Editorial Board, Pramana, Indian, Jr. of Physics*
- *National Lecturer in India (1973-74)*
- *Japan Society for Promotion of Science, Visiting Professor (1974)*

Academic History from College Level:

B.S.	*1962*	*Agra University, 1st Division*
M.S.	*1964*	*Agra University, Stood 1st in University*
Ph.D.	*1966*	*Indian Institute of Technology, Delhi*

Title of Thesis: *Interaction of Electromagnetic Waves with Plasmas.*

Professional Career:

1967-1969	*Princeton University*	*Postdoctoral Fellow*
1969-1971	*Princeton University*	*Research Staff & Lecturer with Rank of Asst.Professor*
1971-74	*Physical Research Laboratory*	*Associate Professor*
1974-75	*Physical Research Laboratory*	*Professor*
1975-1982	*Princeton University*	*Principal Research Physicist* *Lecturer with Rank of Professor in Astrophysical Sciences*
1982-1986	*Plasma Physics Programme Physical Research Laboratory, Ahmedabad*	*Director*
1986-todate	*Institute for Plasma Research Bhat, Gandhinagar, Gujarat*	*Director*

Current Interest

Nonlinear Plasma Theory

List of Publications

About 236 papers in referred Journals, International Conference etc.

Citations

Work extensively cited in Books and Journals. About 750 citations in Citation Index.

In this talk I wish to share with you the deepest urges which drive a physical scientist in his work. I will dwell on questions like -

what do physical scientists do all day, what are the methods they use, what is the world view that is emerging from their work, what are the ultimate goals that are motivating them and why! This is admittedly an ambitious effort and the point of view presented is highly subjective, personal and even debatable.

So, what do physical scientists do all day? We spend most of our time making sense of the material world around us. At first sight, the world around us looks very complex and full of surprises and unpredictable things. But following the methods of science we have discovered a lot of system and order in this apparent chaos. This is our basic search. Of course, once we learn things about nature, we use our knowledge for applications which make life materially more comfortable. This, however, is a subsidiary enterprise.

The method followed is the basic method of science. First we make observations and abstract the essential features from the data these are the basic laws of nature. Next we make hypotheses attempting to explain the data *quantitatively and making new predictions*. A comparison with more experimental data is made and if there is good agreement, the hypothesis becomes a theory. The theories of physics give one a glimpse of the essential truth behind the observed phenomena. But the theories of physics are never supposed to be perfect. They can always be improved upon as more experimental facts become available. The older view is not discarded; we simply become aware of its limitations and range of validity. We thus acquire, iteratively, better and better glimpses of the truth. *The ultimate touchstone is always experimental observation*.........a theory is good and acceptable in physical science, if and only if, it stands the scrutiny of experimental findings!

I will now give one example from Physics, showing how physical scientists use the method of science to converge on a world view of some interesting phenomenon. The example I have chosen is the discovery of the universality of the gravitational force, the weakest force of nature. It was known for a long time that objects released at some height fall to the ground - as if the earth were attracting them. Galileo quantified this phenomenon by doing a series of controlled laboratory experiments on this force. He concluded that the gravitational force is proportional to the mass with the consequence that all objects fall to the earth with the same acceleration. His work led to the remarkable conclusion that a feather and a steel ball in an evacuated tube (where the forces of air resistance are eliminated) would fall to the ground in the same amount of time - a fact which has been verified by subsequent experiments. He gave quantitative numbers for the amount of acceleration suffered by objects as they fell towards the earth. It was then left to Newton to make a bold hypothesis which ultimately led to a theory of gravitation. Newton showed that the moon's orbit around the earth could be quantitatively explained by assuming that the moon is attracted by the same gravitational force which attracts falling bodies on earth, except that one should take account of an inverse square weakening of the force of attraction with distance. Newton's boldness lay in the fact that he postulated that the laws which had been determined in Galileo's terrestrial laboratory had a reach well beyond the confines of the earth it could be used to explain phenomena on the moon - earth scale and later even the scale of the solar system. His theory explained the Copernican laws of planetary systems which had been distilled from the observations of planetary movements by earlier workers. Newton's theory has been verified extensively in the modern era of artificial satellites. Thus Newton's work deserves the title of a theory of gravitation. However, Newton's work is not the last word on the subject. Einstein improved on Newton's theory and showed how gravity is related to the curvature of space time induced by massive objects. This curvature even effects the movement of light ray photons. Einstein predicted that light rays from distant stars moving close to the Sun would be bent by its gravitational field. His predictions were verified during the solar eclipse of 1919 by Eddington and colleagues. Einstein also predicted certain deviations from Newton's theory in the orbits of planets like Mercury, which being closer to the Sun, move with larger velocities. These predictions were also verified by careful observations. Thus Einstein's theory gives a better description of the phenomenon of Gravitation than Newton's view. We thus come face to face with a major tenet of the method of modern science, namely, no theory can claim to give us a glimpse of the absolute truth. We simply keep getting better and better iterations as our understanding improves.

So much about the method of science. Let us now turn to the world view which has emerged from the work of physical scientists. What is this material universe surrounding us? Most scientists agree that a number of observations on the universe are consistent with the view that it has evolved out of a Big Bang which occurred 15-20 billion years ago. Initially, it was only a ball of radiation but as it expanded and cooled, it formed the lightest elements like hydrogen, deuterium etc. Massive gas clouds of hydrogen were rolled by forces of gravitation into star like configurations. Compression of gas clouds led to heating and nuclear furnaces utilising the fusion process were set up inside the stars. This led to the formation of heavier elements. Some times a star would run out of fuel, the inner temperature would go down and the forces of gravitation trying to crush the material of the star would win. This led to supernova explosions and formation of neutron stars and black holes. This also led to the nuclear synthesis of the rest of the heavier elements and a spitting out of a lot of the debris in the form of dust clouds. Those gas and dust clouds are regions where gravity forces keep forming younger stars like our own Sun. Thus the great variety of elements we see around us have most likely been cooked in nuclear furnaces and supernova explosions billions of years ago. Gravity continues to give structure to our universe. It rolls gas clouds into stars, collections of stars into galaxies, galaxies into galactic clusters and galactic clusters into the universe itself. The distances over which gravitation operates, generating patterns that we see, is mind - boggling. Light takes about 8 minutes to come to us from the sun - so the sun - earth distance is about 150 million kilometers. The star closest to us in our galaxy is 4 light years away , that is, nearly 40,000 billion kilometers away. The size of a galaxy is about 100,000 light years i.e. 25000 times larger. The size of the universe with all its patterns of galaxies and galactic clusters is about 20 billion light years that is another factor of 200,000 larger. Thus, the stars we see today may be long dead since light takes so long to reach us. As we look up into a clear starry night, it is an awe inspiring thought that even though we are a tiny speck of matter in this cosmos, we are yet full participants in the whole drama and are built of materials cooked in these stars and/or their dead cousins billions of years ago.

We have finished our overview of the structure of universe. Let us now turn to the complexity of the material forms surrounding us, properties of solids, liquids and gases? Matter is composed of atoms. Each atom has a tiny core, called the nucleus, made of protons and neutrons. The nucleus is positively charged and holds a negatively charged cloud of electrons by attractive electromagnetic forces. Different elements only differ in the magnitude of charge and mass of the nucleus and the resulting difference in the manner in which the electrons are arranged outside. One must use the principles of modern quantum mechanics to understand the internal arrangement of electron clouds in atoms. Most of chemistry can be explained by understanding the reconfiguring of electron clouds when collections of atoms, called molecules, react with each other. The magnitude of the electromagnetic force explains typical sizes of atoms and molecules and also typical energies released in chemical reactions. Dense collections of atoms form solids and liquids, again through electromagnetic interactions. Electromagnetic interactions also explain why some solids are metals whereas others are insulators, semiconductors or even superconductors - why some solids are hard and others soft and so on. Modern theories of condensed matter based on ideas of quantum mechanics can help us understand most properties of materials and even help in the manufacture of new exotic materials with desirable properties. Properties of gases and plasmas can again be understood by methods of statistical mechanics and electromagnetic theory which deal with the behaviour or a large collection of randomly moving particles interacting weakly through electromagnetic interactions. When the systems are close to thermodynamic equilibrium, most phenomena are understood. When the systems are open, with large fluxes of energy and matter passing through them, they generate very complex behaviours like typhoons in our atmosphere, turbulence in water pipes, bursty energy release in stars etc. which are still not fully understood.

So much about the inanimate matter around us. What can we say about living matter? The basic elements of which living matter is made are identical to those in the inorganic world around us. The basic chemistry of interacting molecules is also similar. What seems to be different is a superior organisation of the material in a living system - this is because the living system as a unit or as a member of a species seems to have a goal. How does matter acquire this attribute - this is what we shall concentrate on. Traditionally, anything which is born, ingests material from the environment to grow, reproduces and dies may be called as a living system. But out of all this, what is it that we may call as the 'essence of life? It is well known that the second attribute, namely ingesting materials from the environment to grow is also found in crystals. But the sophistication of a living system is far greater than that of an ordinary crystal. The variety of materials that it can take in from its environment and then metabolize to prevent its own decay (or to grow) is far greater. The basic urge however simply seems to be to perpetuate itself. Similarly, the first, third and fourth attributes above are also aspects of this same essence. Thus death without birth would lead to extinction and is therefore not acceptable. Similarly, birth without death would lead to a flooding of the environment, a cut-throat competition and finally extinction - again something not acceptable to the basic 'essence'! Sexual reproduction and death only seem to be *tricks* learnt by nature to *evolve* and preserve complex systems of matter. In other words, to perpetuate itself in a hostile and dynamic environment it is better to reproduce (and die!) generating offspring with greater variety through mutations, which have a better chance of survival. Thus, eating, metabolizing, mutating, reproducing, dying - all attributes boil down to one essence : *A living system wants to perpetuate 'itself in some form.* What is it that is trying to preserve itself? The most succinct answer is that it is the information contained in our genes - in our DNA, that is trying to preserve itself. These patterns of molecules have evolved over millions of years and do not want to get destroyed! It thus appears that our exterior forms, bodies, brains, reproductive systems, birth, death - perhaps even love - hate relationships, music, culture are all essentially paraphernalia and tricks evolved by this information to perpetuate itself. Or in other words, we may say that *life is simply information preserving its essence by using material and energy from the environment!* Where does this urge to preserve this information spring from? One can argue that the entire web of life has been organized by utilizing a fraction of the top 10 cms of the earth's crust and driving it into a far from equilibrium state with the influx of solar photons. Solar photons bring in low entropy radiation, which is ingested by plants ultimately sustaining the entire web of life. Most of this energy is re-radiated as high entropy photons in the infra-red and the entropy difference is stored in the form of ordered structures that we see in our living systems. Thus life, as we see it, can be understood in terms of the basic principles of modern physical science.

What of consciousness, an attribute of living systems, especially us -humans? This is a highly controversial topic. There are those like me who believe that laws of physical science as we know them today are adequate to explain the phenomenon of consciousness. Then there are those who believe that new laws need to be discovered first. No one can deny that we have built machines which can do a lot of functions that are traditionally done only by humans such as playing chess, making polite conversation, recognizing faces, voices and patterns, proving mathematical theorems (sometimes in totally 'novel' ways) and so on. But the questions that are asked by critics are - do the machines 'understand' what they are doing, are they 'aware' of themselves, do they 'feel' emotions like love, anger, hate, ecstasy and so on. I for one believe that the critics are a bit too hasty. They are comparing us - systems which have evolved over hundreds of millions of years with rudimentary thinking systems which are barely few decades old. As we develop better and better insight into our own frameworks of understanding, how it grows with time, what is the role of memory and experiences, how much of the emotional set-up is genetically hard wired into us and so on - our artificial thinking machines will also evolve and will develop many attributes common to conscious beings!!

This has been a brief tour of the world view of the physical scientists. The key point is that myriads of complex observed phenomena have been classified and understood in terms of the properties of elementary particles interacting via a few fundamental interactions. In fact, there are only four fundamental forces which explain all the observed physical phenomena. These are gravitation, the weakest of all forces, the strong forces which hold a nucleus together against the electrical forces of repulsion among the positively charged protons - the strongest of all forces, the electromagnetic force which holds the atoms together and the force of weak interactions which is responsible for the radioactive decay of a neutron into a proton, electron and a neutrino. These four forces explain all the features of the physical world, including properties of living and conscious matter as we see them. Thus one concludes that there is a tremendous beauty and economy of descriptions in the theories of physical science.

But the search for beauty and simplicity does not end here. There is an enormous effort going on to see if these forces can be unified and derived from some more fundamental principles. A lot of success has already been achieved. First, Salam and Weinberg demonstrated that electromagnetic and weak interactions can be unified into an electroweak force - this force appears as two distinct forces at the low energies that we are familiar with but in high energy accelerator experiments the two interactions appear as a unified force. Secondly, the properties and characteristics of this interaction can be completely derived by demanding that it satisfy certain symmetries - in this case local gauge invariance properties in the appropriate symmetry group. Thus, we not only have a unification of two fundamental interactions, we also have a derivation of all its features from a fundamental symmetry principle. Thirdly, in a new model called the Standard Model one is able to unify strong, weak and electromagnetic interactions and derive the properties from local guage invariance properties of a somewhat enlarged symmetry group. Attempts are now being made to unify gravity into these interactions. But this has entailed abandonment of the concept of elementary particles. One instead assumes that particles are small strings with sizes of order 10^{33} cms which are either open or closed. A theory of supersymmetric strings is currently the favourite theory for one unified theory of all interactions following from simple symmetry principles. But this search is far from complete. The experimental verifications of predictions either for the standard Model or the Theory of Strings is yet to be made!!

But what is the motivation for the search of this ultimate theory - a unified theory of all interactions which can be derived from a symmetry principle. It is matter of faith in the unity of Nature - in its utter simplicity and beauty at the core. It is a faith that although Nature presents very complex forms to us, as we remove its veils one by one, the utter beauty and stunning simplicity of its essence will reveal itself to us. Is this any different from a religious search for getting rid of Maya and reaching the Ultimate Reality -the Brahman?!

Finally, I want to narrate a personal experience to you and leave you with a question. One day I was taking a walk in the evening. The sun was about to set and there were beautiful golden, orange and grey colours in the sky. I suddenly became aware of them and their beauty was so overwhelming that I got rooted to the spot. As I stood there, I lost track of space, time, who I was and where I was. Suddenly, I felt as if I was a dead body burning in a pyre with the winds carrying the gases and my ashes all over. I felt some of my ashes dripping with rain carried into the crevices of the earth, then sucked in by the roots of some plants, the plants eaten by some animals and the animals eaten by a conscious person like me with a pair of eyes looking up. Rest of my ashes were carried by the winds up into the evening sky, scattering the solar light, giving the beautiful colours. A chill ran through me as I realised that I was everywhere - producing this dance of colours up in the skies - enjoying it through those pair of eyes down there. I felt I was perennial - billions of years old and all those eyes which had enjoyed sunsets like this before me were my eyes. I felt I would continue to do so for times immemorial into the future. I stood there in complete harmony with my surroundings!!

My question to you is : Was this a scientific experience or a religious experience?

INDEX

A

Affinities, 80

Agamic Realisation, 100

Agate, 80

Ajapa Gayatri, 104

Algebraic systems, 9

Algorithmic way, 12

Alkaloids, 20

Alleviate poverty, 6

Allopathic doctors, 68

Ambient water, 39

Amino acids, 20

Ancestral house, 67

Anesthetist, 71

Animal cloning, 6

Animal Husbandry, 6

Antigonadal concept, 18

Antipartum Hemorriage, 73

Anupaya sharnbopaya, 121

Apoptotic cell, 87

Aquatic lakes, 37

Aquatic plants, 38

Archaeological excavations, 78

Archaeology, 75

Art of Living, 120

Asarone diol, 20

Asarone - epoxide, 20

Ascend, 120

Asymptotic expansion, 10

Atman, 30

Atomic Energy, 48

Axes, 79

Ayurveda, 62

Azadircahtin, 21

B

Barbara ward, 115

Bhairavenatha, 107

Big Bang, 124, 134

Biological forces, 92

Biomanipulations, 40

Biomolecular Electronics, 33

Biopesticides, 17

Blood Pressure, 66

Bone Tools, 79

Botanical biopesticides, 23

Boundary Element Method, 11

Boundary value, 8

Boxwood, 81

Brahmanda, 126

Breeding system, 4

Bull production, 6

Burials, 79, 83

Burzahomians, 79

C

Calligraphic, 66

Carbonate ion, 39

Carbundes, 63

Carnelian, 80

Cattle moving, 6

Chaitanyam atma, 107

Chebyshev polynomial, 10

Cholera epidemic, 67

Clinical research, 59

Commercial Production, 5

Community Pharmacy, 58

Copernicanism, 91

Cosmic consciousness, 95

Cosmic Mind, 96

Cosmic Web, 110

Crossbreeding, 6

Crowning era, 85

Crystals, 135

Cubic spline method, 10

Cultivation, 44

D

Descent, 122

Desert ecology, 37

Devotion, 120, 122

Diagnosing diseases, 68

Diagnostic acumen, 72

Digital Pair Gain System, 34

Dipteran, 19

Disdained disease, 86

Disease, 63

Dismaying puzzle, 86

Dispense drugs, 56

Divine Grace, 121

Divine Mother, 95

Drainage system, 51

Dynamic energy, 95

E

Ecdysone radioimmunoassay, 21

Eclampsia, 73

Eco-friendly biopesticides, 24

Ecological interactions, 20

Economic revolution, 43

Ecosystem approach, 115

Education, 7

Electromagnetic interactions, 135

Electron clouds, 135

Elliptic boundary values, 8

Elucidated, 20

Embryo transfer technology, 6

Endemic species, 38

Energy, 101

Entomopathogens, 22

Environment, 4

Environmental Advisors, 54

Environmental degradation, 39

Epoxide formation, 20

Eutrophication, 40

Evacuated tube, 133

Excavations, 82

Excision of boils, 63

F

Fabrication skills, 46

Factory system, 93

Feeding deterrence, 19

Fertilized eggs, 27

Fishers, 5

Flavonoids, 20

Flora and fauna, 51

Fluid mechanics, 10, 12

Follicular growth, 19

Forensic medicine, 70

Formidable task, 8

Fundamental solution, 11

G

Galactic clusters, 134

Gametes, 27

Generosity, 66

Genetic dogma, 5

Genotype, 5

Globalisation, 113

Goats, 6

Godhood, 120

Gonads, 19

Granzyme, 87

Gravitational force, 132

Gurgling springs, 75

Gyanam bandha, 107

H

Habitation, 78

Haemolymph, 22

Hakims, 63, 65

Hankel function, 11

Harmony, 116

Health care, 55
Histiocytoma, 86
Horrendous, 92
Hospital Pharmacy, 58
Humanism, 114
Hybridization, 5
Hymenopteran, 19

I

Iconoclastic, 95
Immune cells, 87
Inbreeding, 5
Industrial, 57
Insect pests, 18
Insect species, 20
Insect viruses, 23
Interleukin, 86
Ionic activity, 39

K

Kanda-pura, 127
Karewa lake, 76
Karewas, 76
Keen golfter, 71
Kena upanishad, 123
Kundalini, 101

L

Lalleshwari, 125
Larval instars, 21
Lepidopteran insects, 19
Lethal weapons, 92
Linear homogeneous systems, 13
Liquid orals, 57
Livestock farming, 4

M

Macrophages, 86
Madhyama vak, 100
Maize model, 5
Male sterile, 19
Mammalian systems, 18
Mammalian toxicity, 22
Materia medica, 66
Medical fraternity, 69
Medical representation, 57
Medicinal plants, 62
Medicines, 55
Meliaceae, 20
Microbes, 17
Micro-credit, 6
Microelectronics, 33
Micron, 32
Military Dairy Farms, 5
Milk Production, 5
Molecules, 29
Mycopesticides, 18

N

Nanotechnology, 33

National milk, 6

Natural environment, 115

Naturopathy, 62

Neem, 21

Nematodes, 18

Neolethic Revolution, 77

Neurosecretory cells, 19

Nishandas, 102

Nitrophilous Plants, 37

Non-asymptotic, 10

Non-linear partial, 8

Numerical Linear Algebra, 13

Numerical methods, 9

O

Obstetricians, 72

Oscillations, 77

Ovariandys function, 19

Oxidases, 20

P

Parabolic boundary value, 9

Parallel algorithm, 14

Parama Shiva 108, 120

Parasitoids, 17

Pasyanti, 100

Peclet number, 10

Perforated knife, 81

Periphytic populations, 40

Periphytic rotifers, 40

Personal communications, 70

Pest management, 17

Pesticidal plants, 20

Pharmaceutical journalism, 59

Pharmacists, 55

Pharmacology, 56

Pharmacy, 56

Phenylpropanoids, 20

Photoreceptor, 28

Physicians, 55

Plant breeding, 5

Plants, 27

Playing god, 29

Plethora, 5

Polished stone, 79

Pollen grains, 27

Polyacetylenes, 20

Poultry, 5

Prana, 126

Pratibhijna operates, 105

Pratyibhiyna Darshan, 104

Predators, 17

Prothoricicotrophic hormone, 21

Protozoa, 18

Purpose, 94

Q

Quantum theory, 109

Quinones, 20

R

Raj Tarangini, 61

Real knowledge, 99

Reflective awareness, 110

Religion, 90

Reynolds number, 10

Rudimentary details, 8

Rural populations, 4

S

Saivayoga, 122

Sankalp, 30

Sastras, 119

Satisaras, 76

Scientific growth, 49

Seamless web, 89

Seed kernal, 21

Segregation of genes, 6

Semiconductors, 31

Shaiva systems, 100

Shakti, 27, 101, 109

Sheep, 6

Shetla, 64

Shimmering lakes, 75

Shiva sutras, 107

Shiva-tattva, 121

Singular boundary value, 9

Singular perturbation, 10, 12

Skin layers, 12

Skyscrapers, 92

Smallpox, 64

Solar eclipse, 133

Solar photons, 136

Spanda, 119

Spanda karika, 102

Spanda principle, 103

Species, 4

Sperms, 19

Spherical shells, 10

Spirituality, 90

Surgeon, 71

Sustainable phenomena, 6

Synoptic overview, 50

Systems Builder, 53

T

Tantraloka, 105

Tattvas, 120

Tax, 63

Technological development, 46

Technology assessment, 6

Terminal boundary value, 11
Terpenoids, 20
Thin shallow, 10
Toxic chemicals, 19
Traditional systems, 62
Tridiagonal system, 14
Trika shastra, 119
Trika yoga, 121
Truth, 99
Tumors cells, 86
Typhoid, 64
Tyrannosaurux Rex, 94

U

Uddars, 76
Ultimate Reality, 100, 120
Universal Consciousness, 123
Upyas, 121

V

Vaikhari, 100
Value-neutral, 93
Vedanta, 122
Vestibular Neurovities, 70
Vigyhan Bhaivra, 103
Vimarsa energy, 102
Violence, 92
Vitellogenesis, 21

W

Watch Dog, 53
Water fabrication, 32
Water fern, 38
Wetlands, 37
Wooden beds, 80

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